

# ANNALS of SURGERY

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CONTRIBUTIONS TO BRAIN SURGERY: A. REMOVAL OF CERTAIN DEEP-SEATED BRAIN TUMORS. B. AN INTRACRANIAL APPROACH WITH CONCEALED INCISIONS...	513
WALTER E. DANDY, M.D.....	BALTIMORE, MD.
RENAL TUBERCULOSIS.....	526
MAURITZ PERSSON, M.D.....	STOCKHOLM, SWEDEN
MALIGNANT TUMORS OF THE TESTICLE.....	552
FRANK HINMAN, M.D. AND THOMAS E. GIBSON, M.D., SAN FRANCISCO, CAL., AND ADOLPH A. KUTZMANN, M.D.....	LOS ANGELES, CAL.
RETROPERITONEAL HERNIA.....	576
WILLIAM E. LOWER, M.D. AND C. C. HIGGINS, M.D.....	CLEVELAND, OHIO
OBSERVATIONS ON THE HISTOLOGIC AND PATHOLOGIC ANATOMY OF THE HEPATIC, CYSTIC, AND COMMON BILE DUCTS.....	584
VERNE G. BURDEN, M.D.....	ROCHESTER, MINN.
SPONTANEOUS RUPTURE OF THE SPLEEN.....	598
H. S. HANSELL, M.D.....	Lt. Col., U. S. Army
FASCIAL BANDS AS SUPPORTS TO RELAXED FACIAL TISSUE.....	603
CHARLES CONRAD MILLER, M.D.....	CHICAGO, ILL.
COMPENSATORY LENGTHENING OF THE FEMUR IN CHILDREN AFTER FRACTURE.....	609
WARREN H. COLE, M.D.....	St. Louis, Mo.
ACTIVE MOTION IN THE TREATMENT OF FRACTURES.....	617
JOHN LAWRENCE YATES, M.D. AND G. W. STEVENS, M.D.....	MILWAUKEE, Wis.
TRAUMATIC LUXATION OF THE HEAD OF THE FIBULA.....	635
HENRY H. M. LYLE, M.D.....	NEW YORK, N.Y.
THE EFFICIENCY AND INEFFICIENCY OF CERTAIN SKIN ANTISEPTICS	640
MARTIN B. TINKER, M.D. AND H. B. SUTTON, M.D.....	ITHACA, N.Y.
TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY.....	646
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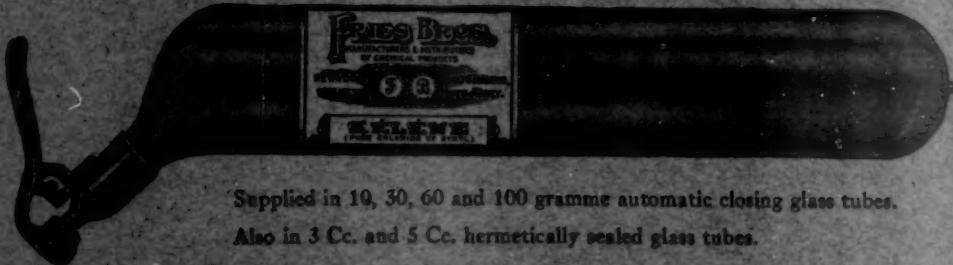
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# ANNALS of SURGERY

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## CONTRIBUTIONS TO BRAIN SURGERY

- A. REMOVAL OF CERTAIN DEEP-SEATED BRAIN TUMORS
- B. INTRACRANIAL APPROACH WITH CONCEALED INCISIONS

BY WALTER E. DANDY, M.D.  
OF BALTIMORE, MD.

FROM THE DEPARTMENT OF SURGERY OF THE JOHNS HOPKINS HOSPITAL AND UNIVERSITY

**A. Removal of Certain Deep-seated Brain Tumors.**—The successful removal of encapsulated tumors on the surface of the brain offers no insuperable difficulties. An accurate and adequate exposure of the tumor, absolute control of hemorrhage at operation with the assurance of no post-operative bleeding, and the avoidance of injury to the brain tissue during the removal of the tumor, are the three great factors upon which a favorable outcome from extirpation of these tumors depends. The accurate localization of all brain tumors now being possible, the exposure of superficially situated tumors should be correspondingly accurate and should be sufficient for the need. With the removal of all such tumors we are not concerned at the present time. But many intracranial tumors—potentially benign—are not so fortu-

FIG. 1.—Drawing to show the character and position of the tumor for the removal of which the procedure here described is used. The tumor is a dural endothelioma arising from the cribriform plate and pushing aside both olfactory nerves.

33

33

33

nately situated. They may be within the brain substance (principally ependymal tumors) but a greater number arise from the meninges (dural endotheliomata) and are partially or entirely hidden from the view offered by any operative approach. To attempt the extirpation of such deeply situated dural tumors by the usual method of shelling them out with the finger, is always a matter of great concern and is attended by a prohibitive mortality rate. Although the causes of this high death rate are readily understood—cerebral trauma and hemorrhage—they are not so easily avoided. The first prerequisite of any operative procedure—a good exposure—cannot be



FIG. 2.—First step in the resection of the left frontal lobe. This resection was necessary to obtain an exposure adequate to permit removal of this tumor. The vessels on the surface of the brain are ligated by two sets of silk ligatures between which the incision is carried to the cortex.

obtained because of the deep and concealed position of the growth. Enucleation is therefore largely performed in the dark. In order to reach the tumor it is inevitable either that the brain be penetrated or strongly retracted, and even then the exposure is transitory and imperfect. Under such conditions bleeding can be controlled only by quickly packing a hidden cavity. An operation so performed is not a procedure of merit but rather a desperate effort. An occasional successful outcome is scarcely justification for the great hazards, even with the otherwise hopeless outlook for individuals so afflicted.

The purpose of this communication is to present a method by which many of these tumors can be exposed. At first glance it may appear radical, but the radical feature has been used in other operations<sup>1</sup> and is now used without

<sup>1</sup> Dandy, W. E.: Treatment of Non-encapsulated Brain Tumors by Extensive Resection of Contiguous Brain Tissue. *Johns Hopkins Hospital Bulletin*, 1922, vol. xxxiii, p. 188.

## REMOVAL OF DEEP INTRACRANIAL TUMORS

apparent harmful effect to the patient. I refer to resection of so-called silent parts, even, if need be, lobes of the brain. Such resections were first tried in the effort to totally eradicate gliomata which otherwise invariably recurred after their partial removal. The seemingly harmless effect of resecting a silent lobe of the brain, is less surprising when we appreciate the fact that at the time the operation is performed, much of the brain tissue which is included in the resected mass has been destroyed by the tumor; and no signs or symptoms of localization have resulted from the destruction of the lobe

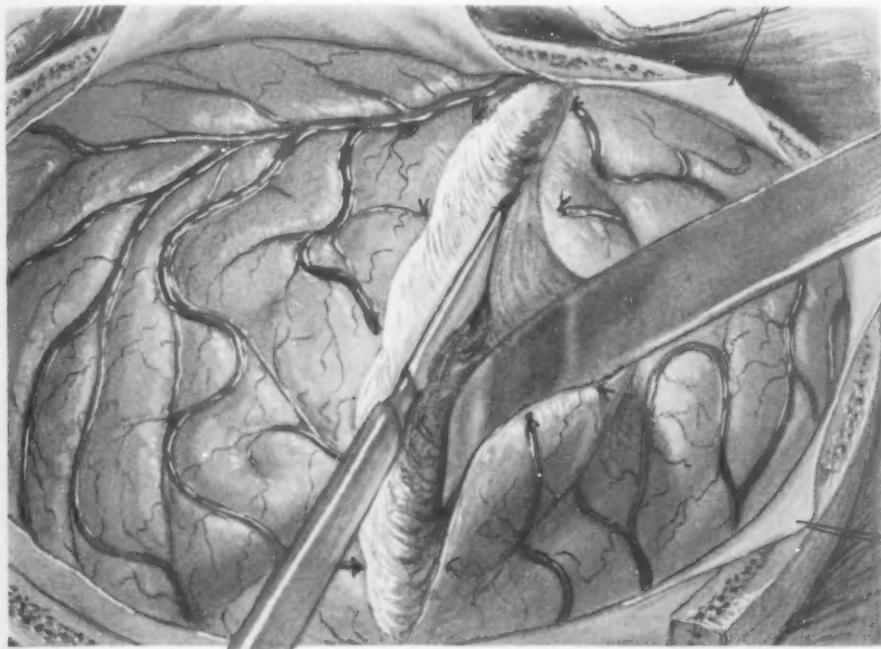


FIG. 3.—The incision is then carried through the frontal lobe. The arteries en route are ligated with silver clips.

by the tumor. Moreover, such disturbances as irritability, forgetfulness, dizziness, etc., due to the tumor's presence (pressure) but of no localizing importance, disappear when the tumor is removed with the contiguous brain tissue.

Frequently during the past few years we have carefully excised varying amounts of cortex and the subjacent white matter (in silent areas) overlying a tumor in order to better inspect the tumor and determine whether or not its character will permit enucleation, and also to help in the more careful dissection of the neoplasm. Cortical resections are on the whole superior to transactions. When tumors are scooped out through an incised cortex, the contiguous brain tissue is always badly traumatized both from the extirpation and even more from efforts at haemostasis. The injury so induced leads to numerous small hemorrhages and a cerebral oedema of such magnitude that not infrequently before closing the wound not only has the cavity from which the tumor has just been removed, become entirely obliterated, but the intra-

cranial pressure may even be greater than when the dura was first opened. This effect of cerebral injury is one of the greatest factors in the operative mortality following the extirpation of brain tumors.

The case which is here reported offers a severe test of the usefulness of this operative procedure since it was necessary to remove, as a preliminary measure, the *left* frontal lobe in a right-handed individual. Though this lobe has long been thought to be most concerned with the intellectual function of

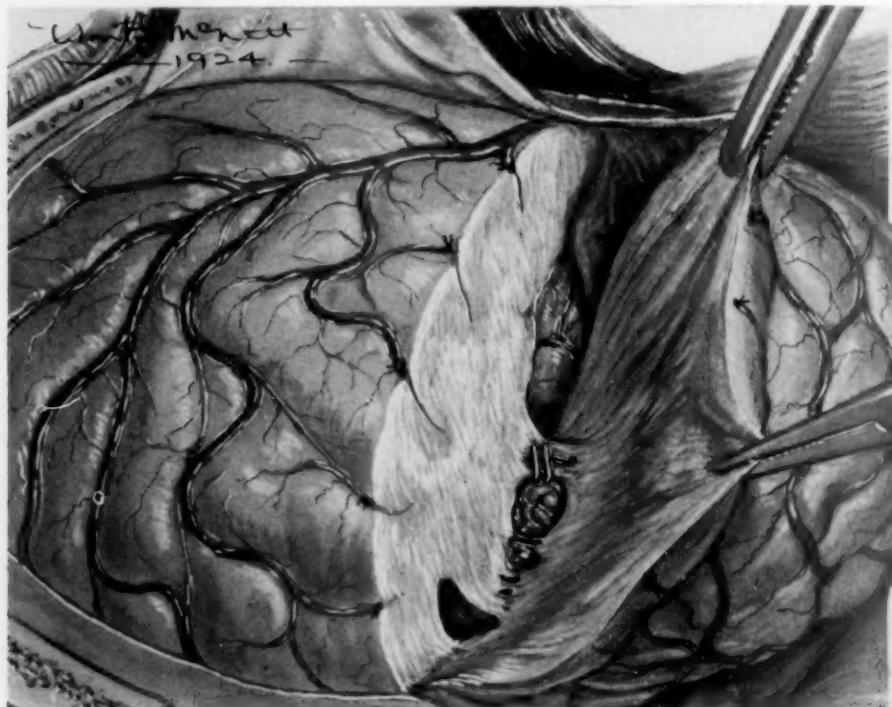


FIG. 4.—Showing the frontal lobe nearly resected, the tumor just appearing behind a vessel which is ligated with silver clips. The anterior horn of the lateral ventricle has been opened near the tip.

the brain, lobe resections have shown that it may be removed without any appreciable mental impairment.

The diagnosis and localization of this tumor offered no particular difficulties. He was a well-developed man of forty-three. For eighteen months he had complained of severe headaches which begin in the frontal region and radiate around both sides to settle in the occiput. At first the headaches occurred every two or three months and lasted from two to five days. Gradually they have become more frequent, now at intervals of two to three weeks. Dizziness frequently and double vision occasionally accompany the headaches. Dizziness is associated with a tendency to fall forward. Peculiar foul odors and tastes for which there is no obvious explanation (uncinate attacks) are associated with these spells, and food taken at these times is either bitter or tasteless. At times there are attacks in which the head draws forward, the neck becomes rigid, blind spots appear, and occasionally there is also a dazzling array of colors. In none of the attacks was there loss of consciousness or generalized convulsions (grand mal). The headaches were always intensified during these spells. He thinks his

## REMOVAL OF DEEP INTRACRANIAL TUMORS

memory is definitely affected during the attacks, but a quick recovery follows. There has been no vomiting.

The only positive findings on examination were: double symmetrical choked disc of moderate grade, complete anosmia, a beginning restriction of the right homonymous visual fields. The reflexes were unchanged; no Babinski, no ankle clonus. The X-ray showed neither a shadow nor an area of destruction. From the findings we considered the tumor's probable location to be under the left frontal lobe.

The disclosure of the tumor was not easy despite a very large bone-flap, which extended far forward over the frontal lobe. Inspection of the entire outer surface of

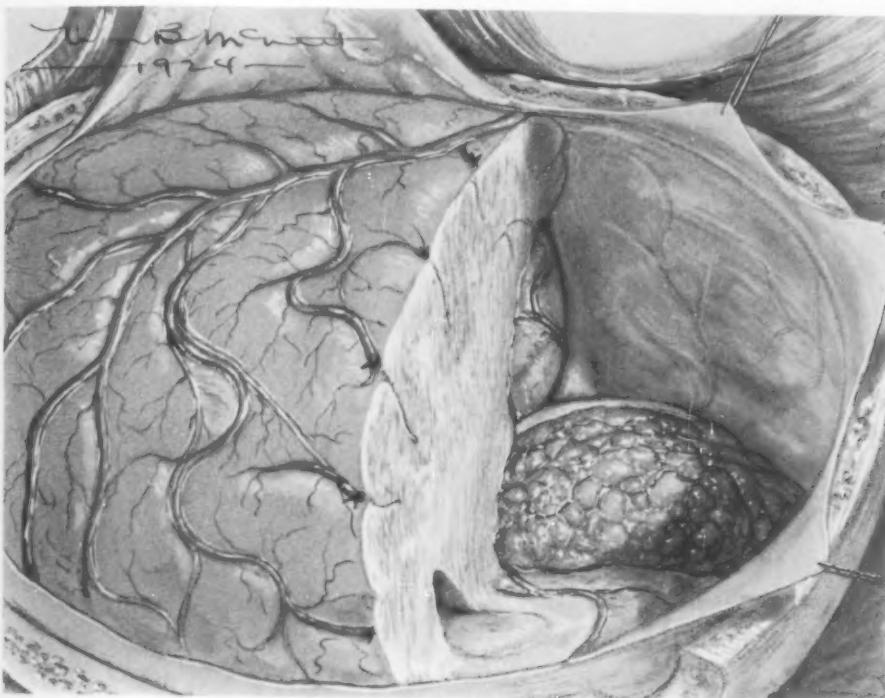


FIG. 5.—Tumor exposed after resection of the frontal lobe. The resection of the lobe has exposed the lesser wing of the sphenoid and therefore the anteriomost part of the middle cranial fossa. With this exposure it was possible to remove the tumor completely.

the left hemisphere and of the inferior surface of the left temporal and frontal lobes revealed no sign of a tumor. The lower part of the frontal lobe, however, seemed a little softer than the neighboring parietal lobe. A ventricular needle was inserted into the area of softening (just anterior to Broca's convolution) and encountered a resistance about 6 cm. below the surface. A nasal dilator was used to follow up the track of the ventricular needle; and when the blades were spread apart the small part of the tumor which was visible was seen to be characteristic of a dural endothelioma—therefore a potentially benign tumor. The inferior surface of the frontal lobe was again inspected and the tumor exposed only when the left olfactory nerve was brought into view. The brain was slightly adherent to the floor of the skull just mesial to this nerve and when these adhesions were gently broken, the tumor could be seen. It was situated almost precisely in the centre of the floor of the anterior fossa of the skull and posteriorly projected over the lesser wings of the sphenoid into both the right and left middle cranial fossae. Firmly attached to the dura of the cribriform plate—from which it arose—this encapsulated tumor extended as far to the right as to the left

WALTER E. DANDY

and was skirted on both sides by the olfactory nerves which were curved around its sides. (Fig. 1.) Situated in this inaccessible position—entirely beneath the brain and under both hemispheres—the operative approach would permit the exposure of only a small fraction of the tumor's surface, and this only by applying undue retraction of the brain, which was already bulging from pressure.

Two courses were open: (1) to leave the tumor in place and be content with a palliative decompression; or (2) to make a better exposure of the tumor by resecting the left frontal lobe and then attempting the tumor's removal. With palliation life might be preserved for some time, but the uncinate and genuine epileptic attacks would not be benefited and sooner or later vision would be lost from direct pressure of the tumor

upon both the optic nerves and the optic chiasm, and of course eventually death was inevitable—altogether at best a most depressing outlook. Any attempt to blindly extirpate such a bloody tumor with the finger would have meant certain death from hemorrhage and cerebral trauma.

From past experiences we were justified in assuming that a resection of the left frontal lobe was comparatively safe and harmless. There seemed no other hope of a successful extirpation. Since the tumor was of the benign, encapsulated and non-recurring



FIG. 6.—Photograph of the tumor; its weight is 36 grams.

type, its successful removal would surely result in a permanent cure, preservation of eyesight, and probably also in the cessation of the epileptic attacks (with the uncinate aurae).

Against removal of the tumor with preliminary resection of the frontal lobe, there was not only the added risk to life, but also the danger of injuring the motor speech centre. The additional danger to life could probably be obviated by the safer plan of removing the tumor at a second-stage operation two or three weeks later, should this appear necessary. The advisability of a one- or two-stage procedure could be left for a decision (depending upon the patient's condition) after the frontal lobe had been resected. And from the results of previous left frontal resections there seemed no doubt that injury to the speech centre (Broca's area) could be avoided.

After carefully ligating the veins entering the longitudinal sinus, the cortical vessels, and the subcortical vessels as they were encountered, the left frontal lobe was excised (Figs. 2, 3, 4 and 5). A safe margin of tissue was left anterior to Broca's area. The resulting cerebral defect extended mesially to the falx and posteriorly to the optic foramen (Fig. 5). Except for the dural attachment, almost the entire surface of the tumor could then be brought into view. By retracting the right frontal lobe, even the right side of the tumor could be seen. The pole of the tumor which projected over the lesser wing of the sphenoid and dipped into the middle fossa compressed the optic nerves—the left as far back as the chiasm—and the internal carotid arteries; though it was not fixed to any of these structures.

## REMOVAL OF DEEP INTRACRANIAL TUMORS

Between the tumor and the adjacent brain tissue a layer of wet cotton was packed to serve as a buffer to prevent bleeding along the base of the brain. The tumor was then lifted from its bed without great difficulty. As is always true in dural tumors, the blood supply was largely derived from the dura. A brisk hemorrhage was temporarily checked by packs of wet cotton tightly applied to the denuded dural surface. When the smaller bleeders had been suppressed the larger ones were gradually isolated and the cotton packs replaced by strips of muscle (Horsley's method). Aside from a severe initial reaction from the operation, his recovery was uneventful. There was neither aphasia nor any contralateral motor weakness at any time after the operation. Writing was unaffected. One year after operation patient writes that he is well in every respect.

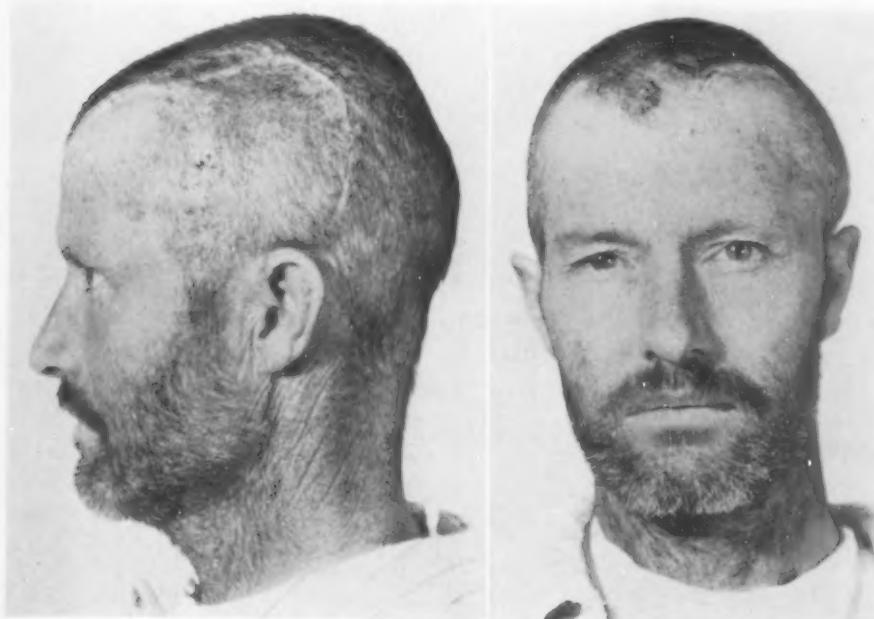


FIG. 7.—Photograph of the patient three weeks after the operation. There was no disturbance of speech, writing, or motor function after the operation, for the incision through the cortex was made just in front of Broca's area and well in front of the motor tracts. It will be noted that the scar following this approach is entirely behind the hair line.

The plane of section of the lobe was through the tip of the anterior horn of the left lateral ventricle which was packed with moist cotton to preclude intraventricular hemorrhage. Somewhat more extensive resections of the right frontal lobe often permit inspection of the foramen of Monro and through it the third ventricle. On one occasion a glioma was seen passing from the third ventricle through the foramen of Monro into the lateral ventricle, but the character of the tumor precluded its removal. The only primary enucleable tumor of the third ventricle which I have been able to locate was removed through a modified approach devised for pineal tumors. In that case the corpus callosum was split far enough forward to allow the foramen of Monro to be brought into view by way of the lateral ventricle.<sup>2</sup>

<sup>2</sup> Dandy, W. E.: Diagnosis, Localization and Removal of Tumors of the Third Ventricle. Johns Hopkins Hospital Bulletin, 1922, vol. xxxiii, p. 188.

WALTER E. DANDY

Such tumors could doubtless be removed with greater ease and safety through a defect created by resection of the right frontal lobe.

For certain tumors situated deeply in the *right* side of the middle cranial fossa, preliminary resection of the temporal or occipital lobes would be justifiable, though of course in such instances contralateral homonymous hemianopsia would result. Section of the *left* occipital lobe posterior to the supramarginal and supra-angular gyri apparently leave no stigmata other than a right homonymous hemianopsia. The inclusion of these sensory speech areas could hardly ever be justifiable even with preservation of life. There is usually no need of a decompression following resection of a cerebral lobe for the defect created by the missing lobe will usually more than compensate the œdema which follows.

SUMMARY

A case is presented of a dural endothelioma (an encapsulated benign tumor) arising from the covering of the cribriform plate, occupying both sides of the cranial chamber to an equal degree. The tumor was completely removed after a preliminary resection of the left frontal lobe. No loss of function of any kind followed the operation. This procedure (resection of a silent cerebral lobe in part or whole) is advocated as a method for the removal of certain intracranial tumors known to be benign and which are situated at such a depth as to be in large part or wholly hidden from view.

The purpose of the method is to provide a good exposure of the tumor so that the brain may not be injured in reaching and removing the tumor; that the tumor may be extirpated carefully, and that bleeding may be controlled deliberately instead of being left to chance.

**B. An Intracranial Approach with Concealed Incisions.**—The accompanying drawings illustrate a craniotomy approach which was designed to leave the operative scar concealed. Most routine craniotomy incisions, and all in which the frontal lobe or hypophyseal regions are explored, cross the forehead in front of the hair line, leaving scars of varying extent permanently visible. As the hair line recedes, naturally the scar lengthens. While careful and painstaking closure of wounds has made scars far less obtrusive, at best they are an unwelcome adornment.

The incision of this approach is not uniform, considerable latitude being allowed owing to the different shapes of the hair line. In a general way, it may be said that two small more or less U-shaped adjoining skin-flaps (Fig. 3) are made instead of a single large one, a middle limb serving both as the back of the anterior and the front of the posterior skin flap. The base of the anterior flap is directed toward the orbit, the base of the posterior downward toward the zygoma backward much as the posterior half of the customary curvilinear craniotomy incision. When exposure of the frontal

INTRACRANIAL APPROACH WITH CONCEALED INCISIONS

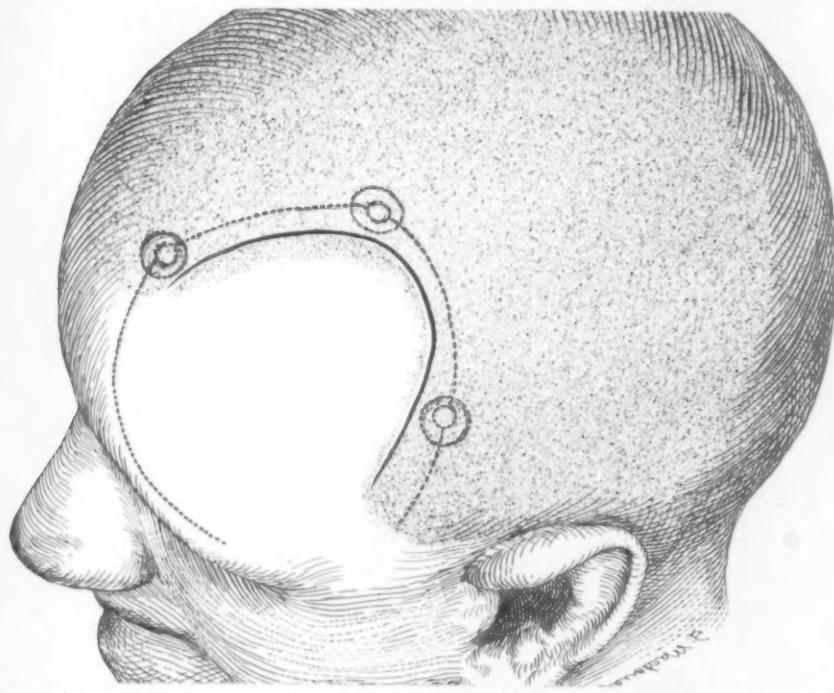


FIG. 1.—A concealed approach for the exposure of the frontal lobe alone. The solid line represents the skin incision; the dotted line the bone flap. Such a small flap is used only on special occasions.

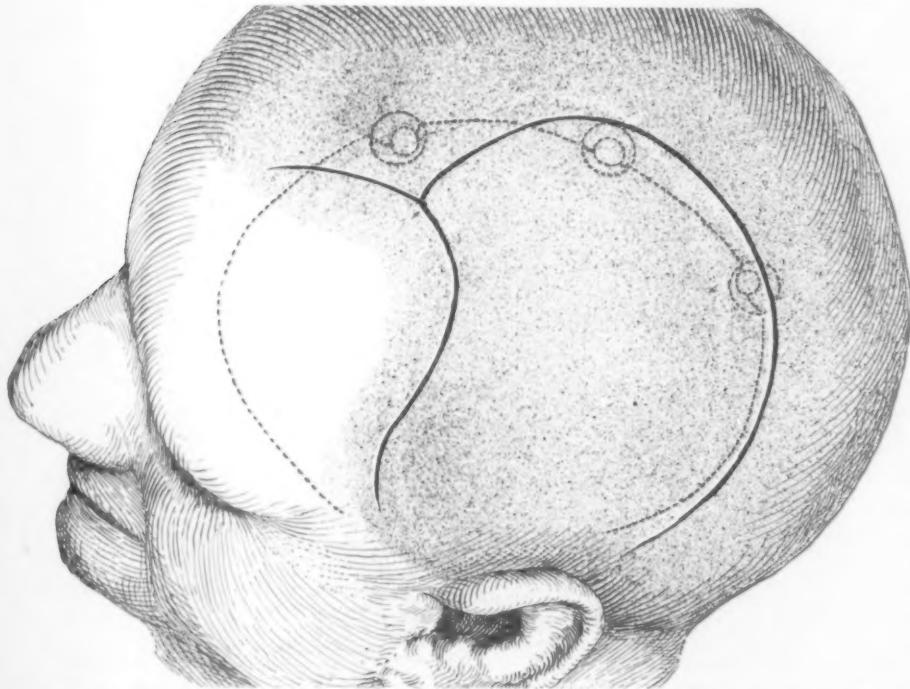


FIG. 2.—The solid line indicates the skin incision; the dotted line the bony incision. When the anterior skin flap is reflected forward the bone can be cut almost to the supraorbital ridge without a visible scar.

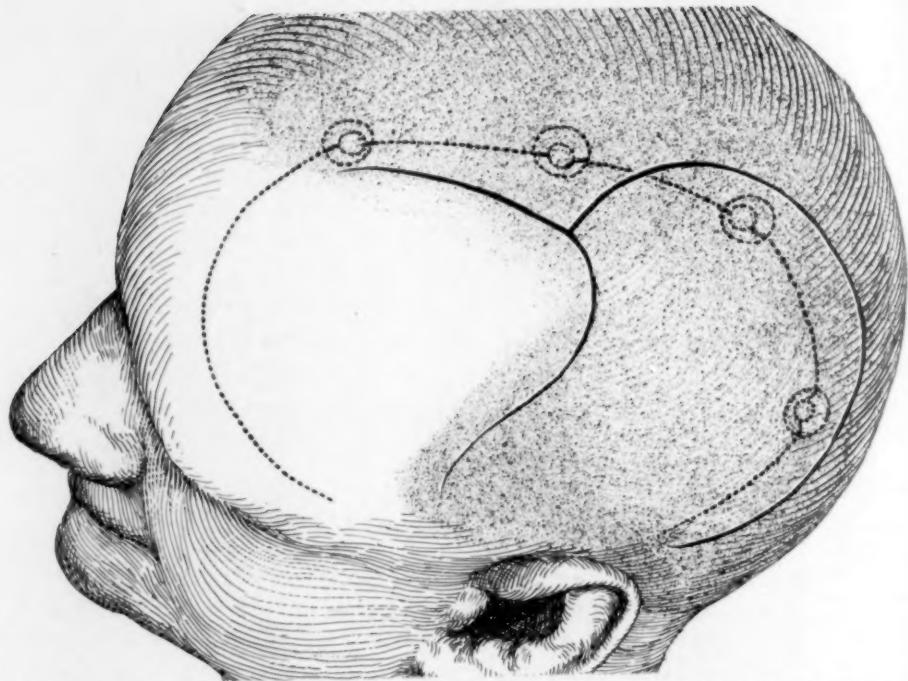


FIG. 3.—When the hair-line has receded, the skin incision can be made to conform to its shape without disadvantage.

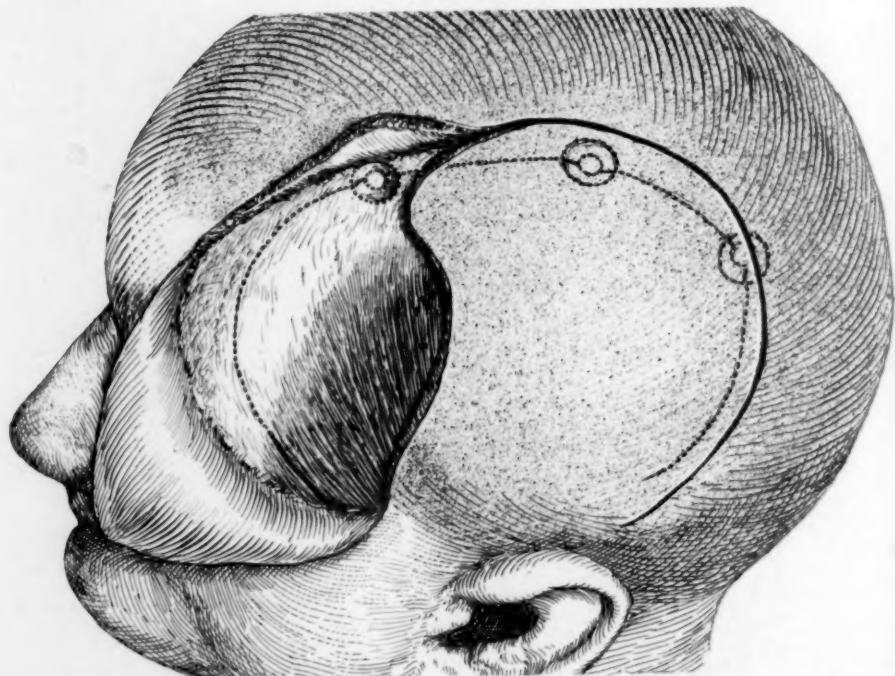


FIG. 4.—The anterior flap of skin is reflected showing the temporal muscle attachment. The dotted line indicates the incision of bone and the solid line through the temporal incision indicates where these fibres are divided prior to cutting bone beneath. This approach is used in all hypophysis tumors demanding an intracranial operation.

#### INTRACRANIAL APPROACH WITH CONCEALED INCISIONS

region is not desired, the posterior flap outlined and a short straight or curved spur, one to two inches, is projected forward at right angles to its limb (Fig. 2). In effect the result is precisely the same, except in degree, as with the foregoing incisions. The anterior skin flap is reflected anteriorly, the line of cleavage of the dissection being between the galea aponeurotica and the

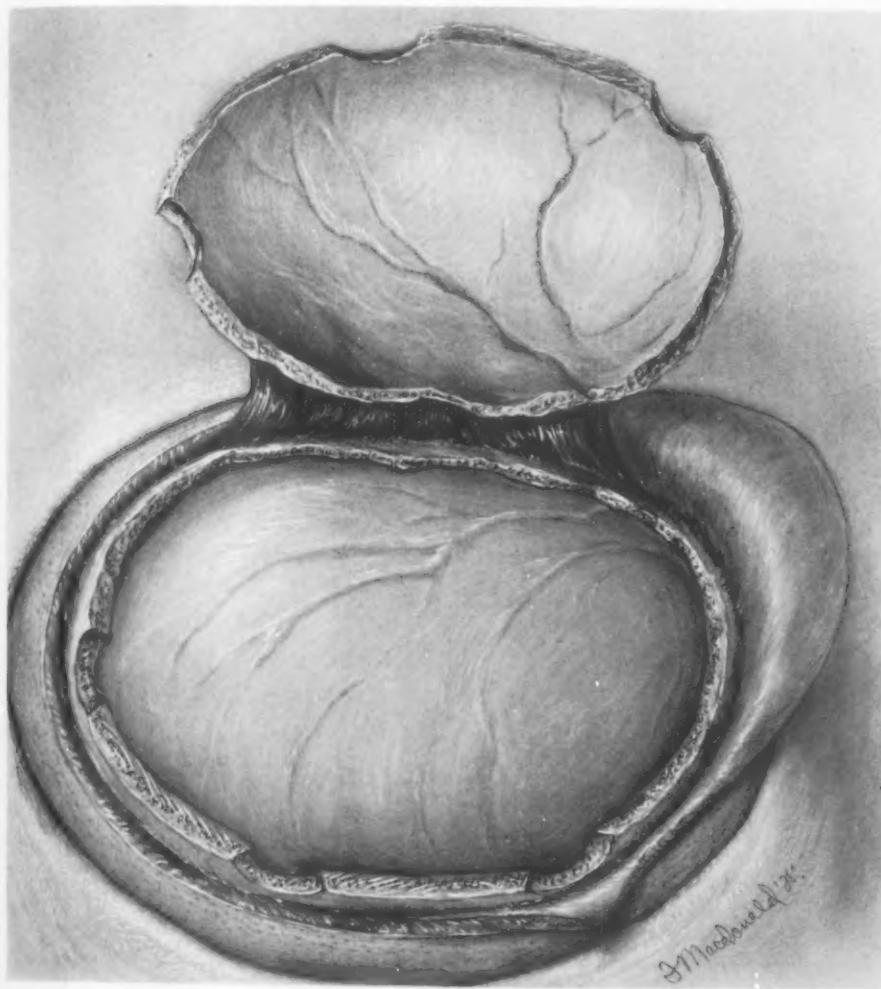


FIG. 5.—Demonstrating the end result of the approach drawn in Figs. 2, 3 and 4.

periosteum. The posterior flap is reflected later with the bone. The temporal muscle is incised parallel to its fan-shaped fibres, anteriorly as far as the reflected flap will permit and posteriorly directly under the skin incision (Fig. 4).

The perforator openings in the bone are so placed as to be covered by the hair, thereby avoiding a slight depression which otherwise might follow. At times when additional reinforcement of a bevelled edge is advisable, an extra

WALTER E. DANDY

perforator opening is made anteriorly under the temporal muscle which covers the bony defect.

When the hypophyseal region is to be explored it is advisable to carry the anterior limit of the skin incision 1 to 3 cm. onto the uncovered forehead (Fig. 4). With this additional extension it is possible to reflect the anterior skin flap to the supraorbital ridge and to section the bone at the anterior-most



FIG. 6.—Showing the scar beneath the hair-line when only the anterior flap has been used. In this case a large dural endothelioma was removed from the frontal lobe. Photographed ten days after operation.



FIG. 7.—Showing the anterior extent of the skin incision in a patient whose entire frontal lobe was resected in two stages.

part of the cranial chamber. I have used this approach exclusively for hypophyseal tumors for several years.

The entire frontal region of the brain can be perfectly exposed by the anterior flap alone (Fig. 1). This restricted approach is recommended particularly for tumors involving the frontal bone before the exposure of lesions (other than tumors) of the frontal lobe. Recently this exposure was ample to permit the removal of a large dural endothelioma of the frontal lobe (Fig. 6). However, except in unusual intracranial tumors, one desires a maximum rather than a minimum exposure.

It will be noted that in the major approach, much of the incision through bone or dura is not immediately beneath the skin incision. Not only is the possibility of an occasional cerebrospinal fluid fistula thereby made more

#### INTRACRANIAL APPROACH WITH CONCEALED INCISIONS

remote, but the danger of an accidental skin infection being carried to the underlying bone or brain is of less concern.

The approaches mentioned have been used in practically every case (except where the patient was bald) of cerebral tumor or craniotomy for other purposes, for several years. Among the first cases, the angle where the incisions joined occasionally failed to heal perfectly, but with care in preserving the circulation by a painstaking closure at this point there has not since been the slightest defective healing.

## RENAL TUBERCULOSIS

A CLINICAL SURVEY OF 295 CASES, 90 OF WHICH WERE NOT OPERATED ON  
BY MAURITZ PERSSON, M.D.

OF STOCKHOLM, SWEDEN

FROM THE SURGICAL DEPARTMENT OF THE SERAPHIMER HOSPITAL OF STOCKHOLM,  
PROFESSOR J. AKERMAN, SURGEON-IN-CHIEF

### SYNOPSIS

- I. Statistical data.
- II. Symptomatological survey.
- III. Post-investigation of non-operated cases.
  1. Mortality and causes of death.
  2. Patients surviving, and their condition.
- IV. Post-investigation of operated cases.
  - A. Nephrotomy and kidney resection.
  - B. Nephrectomy.
    - a. Bilateral renal tuberculosis.
    - b. Unilateral renal tuberculosis.
      1. Operative mortality and causes of death.
      2. Late mortality and causes of death.
      3. Patients surviving and their condition.
      4. Operative technic and wound healing.
      5. Bladder tuberculosis; its prognostical importance.
      6. Pregnancy and delivery in nephrectomized women.
  - V. Summary.

The present paper is a clinical study of the renal-tuberculosis material obtained at the surgical clinics of the Seraphimer Hospital, Stockholm, during the period 1890-1920. The year 1920 has been fixed as a limit-year in order to allow of sufficient lapse of time after treatment in the hospital to permit of an opinion being drawn regarding the final results. The diagnoses have, in all the cases, been determined by: (1) Proving the presence of *pus-cells* and *tubercle bacilli* in the urine, either by the microscope or by guinea-pig test; (2) a *histological examination* of the extirpated kidney, or, (3) by *autopsy*. From the analysis there have been excluded 36 cases operated on during the period in question, where the extirpated kidney has, macroscopically, shown tuberculous alterations, but where tubercle bacilli have not been shown in the urine, and where the kidney has not been investigated histologically, or preserved.

### I. STATISTICAL DATA

1. *Sex*.—In the material, men are in a great majority. Among those operated on, men are also in the majority, although not to such a high degree, as will be seen from the appended table:

Entire material	295	Men	194 (65.8%)	and women	101 (34.2%)
Operated	205	Men	123 (60 %)	and women	82 (40 %)
Not operated	90	Men	71 (78.9%)	and women	19 (21.1%)

## RENAL TUBERCULOSIS

In these figures, consequently, we trace a relative displacement in favor of women in respect to cases that have been operated on.

2. *Age*.—It is a general observation that chronic kidney tuberculosis is most frequent in the third and fourth decades of life. This circumstance becomes plainly evident in the present material, where more than 64 per cent. of the cases fall within the above mentioned age-groups.

1st decade	5 cases	5th decade	38 cases
2nd decade	46 cases	6th decade	13 cases
3rd decade	85 cases	7th decade	4 cases
4th decade	104 cases		

The five cases in the first decade were: One in the seventh, three in the eighth and one in the ninth year of age. Chronic kidney tuberculosis is considered to be very rare in this age-group. *Wildbolz*<sup>14</sup>, for instance, among 245 cases did not discover a single instance, and *Braasch*<sup>2</sup> discovered no more than two in 532 cases.

Subsequent to the fourth decennium we find the frequency rapidly decreasing, and, after the seventh, there is not a single case.

3. *Side*.—In the material examined, the cases are divided as follows:

Cases operated on .....	205	Cases not operated on .....	90
Of these: right side .....	109	Of these: right side .....	15
left side .....	88	left side .....	10
both sides .....	8	both sides .....	38
		side unknown .....	27

In some instances, however, our methods of investigation which, unfortunately, are still far from perfect, may have led to a faulty determination in one direction or the other. In four of the double-sided cases, the operation was made with the premise that the tuberculosis was unilateral, and it was not until autopsy that the bilateralism was discovered. It is difficult to say how many of the non-dissected cases, especially the earlier ones occurring in the material, were in reality bilateral when they were operated on, although they had been considered, and were treated as, unilateral cases. Even with the resources we have at our command at present, it is probably impossible to discover a very early kidney tuberculosis before pus-cells and tubercle bacilli are discovered in the urine from the kidney in question, *i.e.*, before a closed tuberculous focus has broken into the kidney pelvis. In reality, however, such a source of error is probably not very great. In cases of secondary bilateralism, *i.e.*, where infection of the second kidney has occurred from the first affected kidney, there will probably exist a great possibility of proving alterations in ureter-urine, for we suppose that the spreading to the other kidney usually takes place via a secondary tuberculosis of the bladder and infection ascending along the ureter. Those instances where bilateral tuberculosis can easily be overlooked are, consequently, chiefly the primary bilateral cases. These are, undoubtedly, rare. Chronic kidney tuberculosis most certainly develops as a rule, unilaterally at first, and remains so for a fairly long period.<sup>14\*</sup>

With the above reservations, we find in the material at hand, if we neglect the uncertain cases, a determined bilateralism in about 17 per cent. of the cases. Of the 33 instances that have proceeded to autopsy, the tuberculosis was double-sided in 12 cases. Of the 16 cases not operated on and that were obducted, 8 were bilateral.

4. *Coincident Tuberculosis in Other Organs*.—Although we probably all agree that primary kidney tuberculosis, in the real sense of the word hardly occurs, it is far from the part that in every case of surgical kidney tuberculosis, evidence can be shown of other tuberculous lesions still existing in the patient, or that have healed. A primary kidney tuberculosis presupposes that the tubercle bacilli enter the body without causing any

\* In this material there is an instance which was operated on, with ideal results, seven years after the diagnosis of unilateral kidney tuberculosis had been determined. The patient lives and is in good health, now 10 years after the operation.

## MAURITZ PERSSON

alterations in the entrance, and that they reach the kidney *via* the blood-vessels, without giving rise to any anatomical alterations on their way thither. We do not deny this possibility, but, practically speaking, one manifestation or another of tuberculosis, has, probably, always preceded tuberculosis of the kidneys, although, in many instances, the clinical symptoms of the first may have been so little noticeable that the tuberculosis of the kidney has apparently been primary.

Among 300 patients suffering from renal tuberculosis, who were subjected to complete clinical and röntgenological investigation of the lungs, *Braasch*<sup>3</sup> discovered signs of pulmonary tuberculosis in the case of 84, or 28 per cent. Tuberculosis of the bones was found in 6 per cent. of a total number of 346 patients.

In the material of the Seraphimer Hospital, symptoms of other tuberculous lesions was discovered in 150 patients, or about 50 per cent. of the whole number, in accordance with the following table:

Pulmonary tuberculosis .....	66 cases	22.4 per cent.
Genital tuberculosis .....	46 cases	15.6 per cent. in men.
Bone and joint tuberculosis .....	21 cases	7.1 per cent.
Pleuritis .....	7 cases	
Lymphadenitis .....	10 cases	

5. *Hereditary Tendency*.—In the 142 cases where positive or negative statements of this factor existed, the occurrence of tuberculosis among relatives was found in 36 cases, and the absence of or ignorance of such tendency in 106. Hereditary tendency could, consequently, be traced in about 25 per cent. of the cases. *Lower and Shupe*<sup>10</sup> found a corresponding figure of 29.5 per cent. among 61 cases.

## II. SYMPTOMATOLOGICAL SURVEY

According to current experience, the clinical picture of kidney tuberculosis is multifarious. The subjective troubles first noted by the patients in the present material vary in fairly high degree in different cases. The following table shows their relative frequency:

Slowly progressive, chronic cystic symptoms .....	200	(68.5%)
Of which, with haematuriae .....	122	
without haematuriae .....	78	
Acute cystic symptoms .....	16	( 5.5%)
Of which, with haematuriae .....	10	
without haematuriae .....	6	
Dull pains in kidney region .....	27	( 9.2%)
Of which, with later cystic symptoms .....	21	
Renal colic-pains .....	26	( 9.2%)
Of which, with later cystic symptoms .....	20	
without later cystic symptoms .....	6	
Initial, fairly great haematuria .....	16	( 5.5%)
Of which, with later cystic symptoms .....	12	
without later cystic symptoms .....	4	
Sepsis ex abscessu perinephritide .....	1	
Perfectly free from subjective symptoms .....	6	

*Bladder irritability*, consequently, is the most common symptom, and was found in 74 per cent. of the cases. Then comes *pain in the kidneys*, with 18.5 per cent., half being dull pains and the other half of a colic-like nature. The third place is occupied by *haematuria*, with 5.5 per cent.

Six of the cases belong to the symptomatologically perfectly indolent type. In one of them, miliary tuberculosis broke out after a fracture of the pelvis, and on autopsy a kidney tuberculosis was discovered. The other five were under observation for other complaints, and kidney tuberculosis was found merely as a result of routine examination.

## RENAL TUBERCULOSIS

During the latter part of the course of the disease, there appeared macroscopic *hæmaturia* in further 45.2 per cent. of the cases. On one occasion or another, this was the case in, altogether, more than 50 per cent. of the instances. Symptoms of bladder irritability appeared during the latter part of the course in 18.1 per cent. of the cases. Thus, such instances occurred in more than 92 per cent. of the cases during longer or shorter periods. Among these there was noticed a markedly periodic remittent course in 38.6 per cent. of the cases, and an evenly progressive course in the remainder.

*Incontinence* has occurred in, altogether, 8 cases, i.e., in about 2.7 per cent. In two instances, children of from 7 to 8 years of age, this was of a markedly nocturnal type. In the other six, it was different, being both nocturnal and diurnal. In one instance, a woman 46 years of age, whose complaint began as an acute cystitis, such involuntary passing of the urine had continued 19 years, and had not been preceded by any desires to urinate, with the exception of during the very earliest part of the period. During all these years this had constituted the patient's only symptom, with the exception of some slight pains that had been felt on a few occasions in the left side of the abdomen. In three of the instances, incontinence appeared periodically as a symptom of deteriorating chronic cystitis. Two of the patients were men of 26 and 28 years; three were women of 18, 46 and 66 years, and three children between 7 and 12.

In all the cases of incontinence, kidney tuberculosis proved to be in a relatively advanced stage, in five instances bilateral and in the other three unilateral, but with the diseased kidney much tuberculated. Casuistics, therefor, display no instance where incontinence has been an early symptom in the real sense of term, but, on the other hand, it is evident that the mucous membrane of the bladder has not necessarily been macroscopically tuberculated in any very great degree, for there are two instances where alterations of the bladder have been limited to a slight redness or a slight ulceration around one ureteral orifice.

*Polyuria*.—Although the material is not completely examined with regard to this question, it is evident that, in many instances, the amount of urine has been larger than the normal, in many instances exceeding 2000 grammes per day.

*General Symptoms*.—Loss of weight, diminution of vigor, loss of appetite, etc., have occurred in 51 per cent. of the cases. The loss of weight has, in most instances, been moderate; only in one or two cases has it exceeded five kilogrammes.

*Urine*.—The reaction was acid in 88.7 per cent. of the cases, amphoteric in 7 per cent. and alkaline in 4.2 per cent. In 11.5 per cent. of the cases with acid reaction secondary infection existed; in one half, *coli*, and, in the other, *strepto-* and *staphylococci*. In 33 per cent. of the cases with alkaline reaction there existed secondary infection.

Albumin was found in 97.5 per cent. of the cases, 10.2 of which only as traces, but in the rest in to a somewhat more considerable extent; in no instance, however, did it exceed 6 per cent. usually one per cent. In 7 cases Heller was negative, after tests 1-3 times repeated. Rovsing<sup>12</sup> has pointed out that, such cases without albuminuria are not so extraordinarily rare. Among 200 cases he found where albuminuria was altogether absent, or where it only appeared intermittently.

The sediment contained pus-cells in every instance, from relatively unimportant quantities to unheard-of masses; in no instance was the amount so small that the pus-cells could be noted as "rare." Microscopic blood, or reliable statements as to the occurrence of blood in the urine occurred in 68 per cent. of the cases. The corresponding figures in Crabtree and Cabot<sup>4</sup> was 64.2 per cent.

*Tubercle-bacilli* were demonstrated microscopically in 78.3 per cent. of the cases, and by guinea-pig test in a further 7.1 per cent., or a total of 85.6 per cent. In the other instances, the diagnosis has been verified by histological examination of the extirpated kidney. Ekehorn<sup>5</sup> states that there ought to be no difficulty in demonstrating tubercle-bacilli in 80-90 per cent. of the cases.

*Palpable Kidney*.—In 76 cases, or about 25 per cent., the diseased kidney was palp-

## MAURITZ PERSSON

able, more or less enlarged and, in most instances, quite tender to pressure. In 27 cases, or about 9 per cent., with non-palpable kidney, there was tenderness to pressure or muscle-tension over the place of the kidney. In 6 cases the healthy kidney was found to be palpable but not tender to pressure, while no local symptom could be demonstrated by palpation on the diseased side. Ekehorn<sup>5</sup> and Wildbolz<sup>13</sup> declare this symptom to be a sign of compensatory enlargement. In the majority of cases, 63 per cent., there existed no external symptoms from the kidneys.

### III. POST-INVESTIGATION OF NON-OPERATED CASES

In judging the value of nephrectomy in renal tuberculosis a comparison between the later course of the disease in the nephrectomized and the non-nephrectomized cases is of interest. Among the 90 reliable cases which, as regards the diagnosis, fulfilled the conditions stated in the introduction, but which, for one reason or another were not subjected to nephrectomy, 38 were double-sided, so that there was no question of an operation. In 27 instances it was impossible to decide if the tuberculosis was unilateral or bilateral, in consequence of extreme bladder alterations which rendered ureteral catheterism impossible. In 15 cases the tuberculosis was right-sided and in 10 left-sided. In most of these 25 instances no operation was carried out in consequence of the patient's refusal to submit to one. In some few instances, operation was contra-indicated by manifest pulmonary tuberculosis in an advanced stage.

1. *Mortality.*—Of the 84 cases in which reliable information has been obtained on post-investigation, 71, or 84.5 per cent. of the non-operated patients are dead. Since the beginning of the disease there have died within two years, 26 = 31 per cent.; within three to five years, 27 = 32 per cent.; within six to ten years, 12 = 14.3 per cent.; after ten years, 6 = 7 per cent.

There have thus died within the first five years after the beginning of the disease 63 per cent. of the non-nephrectomized cases. For the sake of comparison there is given an investigation by Wildbolz.<sup>14</sup> Of 316 non-operated patients, there died within two years 33.3 per cent.; within five years a total of 58 per cent.

A life's-length of more than ten years has been shown in the cases of 12 patients, or 14.3 per cent.

Of the 25 cases of unilateral renal tuberculosis where operation was considered indicated but was not carried out, two have not been found. Of the remaining 23, there have died 16 within five years, or about 70 per cent. A total of 19 have died, or 82.6 per cent., a mortality, consequently, which is in very good agreement with that of the whole of the non-operated material (84.5 per cent.).

*Causes of Death.*—Kidney and urogenital tuberculosis and its sequels, general cachexy and uræmia are in great preponderance, forming about 80 per cent. Next come acute miliary tuberculosis, with 8.4 per cent., and, finally, a few cases from other causes: Pulmonary tuberculosis, 2. Morbus Addisoni, 1. Tub. peritonei et intest., 1. Cystoscopic injury, 2. Paralysis cordis e CHCl<sub>3</sub>, 1.

## RENAL TUBERCULOSIS

2. *Surviving Patients.*—Of the 13 surviving cases, one of which has been observed for 27 and six for more than ten years, five have been personally examined by the present writer. The remainder have sent in written detailed replies respecting their condition. The following groups are distinguished:

a. *Unimproved and Worse.*—Of the 8 cases in this group, 6 were bilateral with pus-cells and tubercle bacilli from both ureters; one was unilateral, with healthy urine from the one ureter, and, finally, one unknown if the case was uni- or bilateral (only one ureter catheterized, and in the urine from this there were discovered pus-cells and tubercle bacilli). The longest period of observation since the beginning of the symptoms is fourteen years; the shortest four.

A common characteristic of all these cases is that the symptoms continue to trouble the patients just as much as, or more than, they did during the stay at the hospital. At the time when the patients were post-examined, they were not fully capable of working. The weight is unchanged, or displays some little increase. The desire to urinate is frequent; as much as twice in the hour. In all the cases but two, there still occurs a smarting pain on urination. The urine is now and then mixed with blood, but otherwise usually clouded. In the three instances that the present writer has had the opportunity of examining personally, there were still found tubercle bacilli in the urine, together with pus-cells. In the single instance in which the writer has had the opportunity of making a cystoscopic examination, there was discovered considerable bladder alterations, which rendered ureteral catheterization impossible. One of these cases is of interest insofar that, for more than three years it displayed an increasing improvement in all the symptoms, and then afterwards grew worse. This was the only instance of unilateral tuberculosis in this group.

b. *Subjectively Improved.*—This group includes three cases, none of which was determined as bilateral. The period of observation: 21, 15 and 12 years, respectively. None of these cases has been investigated by the writer personally, but his statements are based on the written information supplied by the patients.

A common feature of the cases is that the symptoms continue in a more or less marked form, although more slightly than during the patient's stay at the hospital. The patients are either quite capable of work, or almost so. Two of them have increased in weight; one is of the same weight as at the hospital. The urine is stated to be clear, and, excepting for a short time after the patient's leaving the hospital, has been free from blood. The desire to urinate occurs once every three or four hours. During the last few years, urination has caused no smarting. It is stated that tuberculosis has not appeared in any other form since the stay at the hospital. The urine has not been examined for tubercle bacilli nor has a guinea-pig test been made.

c. *Subjectively Restored to Health.*—This group of non-nephrectomized cases, which is of importance from many points of view embraces two cases, both unilateral. The period of observation, from the beginning of the

MAURITZ PERSSON

symptoms, is 27 and 17 years, respectively. In both instances, the writer has had an opportunity of carrying out personal post-investigations, supplemented by guinea-pig tests of the urine.

Common to both cases is, that the subjective symptoms have disappeared without a trace. On examination, the patients were found to be perfectly able to work; they have increased, respectively, 13 and 9 kilogrammes in weight. Desire to urinate, normal; three times a day, 0-1 at night. No pains on urination or otherwise. The urine clear, never blood-colored during the last few years. No albumin in the urine, nor any tubercle bacilli or other bacilli. In the one instance there were some few leucocytes; in the other, no sediment. The guinea-pig test in one case (the oldest) resulted negatively; in the other positively.

As these cases are worthy of interest, a summarized history of the illness is here appended:

(1) Female, twenty-four years of age (11.77/1897). Diagnosis: *Tbc. ren. dxt.* In September, 1896, there occurred at intervals of some days, an aching in the region of the right loin and the bladder, accompanied by vomiting, frequent desire to urinate, and cloudy urine. In December, 1896, sharp pains in the abdomen on urination, and, occasionally, blood in the urine. The symptoms continued with varying intensity until admittance to hospital, February 6, 1897. *Status:* Good general condition. Pale. Temperature  $37^{\circ}/38^{\circ}$  C. Frequency of urination was every third hour by day, and a couple of times by night. The right kidney palpable, somewhat enlarged; tender. Amount of urine daily 2000 c.cm. Urine cloudy; slightly acid; traces of albumin. Large numbers of white blood-corpuses and numerous tubercle-bacilli in the sediment. The patient was treated with salol, 1 gramme three times daily, and lavation of the bladder with lapis infernalis solution. Discharged March 13, 1897, subjectively improved. Pains in the right side then less severe; desire to urinate slighter and less frequent; urine clearer. A couple of months after discharge from hospital, the desire to frequent urination and the smarting pains disappeared and the urine became crystal-clear. Since then, there have been no difficulties with regard to urination. In 1921, occasional symptoms of *ulcis duodeni*. Admitted to the medical clinic 1 (Prof. I. Holmgren) July 3, 1922. Röntgenological determined *ulcus-recess* in duodenum. July 12, haematemesis of about one litre blood. Discharged August 23, for further attendance at home. No improvement. Readmitted to medical clinic January 10, 1923. Right kidney palpable. Urine acid. Heller negative. In sediment, fairly large numbers of white blood-corpuses and *coli-bacilli*. No tubercle bacilli. Guinea-pig test negative. January 19, *Cystoscopic examination:* bladder contents 300 c.cm. Walls of bladder pale and without ulcerations or granules. Left ureteral orifice without remark. Catheter enters about 30 cm. Right ureteral orifice could not be found. In urine sediment from left ureter a few red and white blood-corpuses, and a very few *coli-bacilli*. 5 c.cm. 0.4 per cent. indigocarmine solution injected intramuscularly. After a quarter of an hour there ran from the left ureter a blue-green colored urine. From the place of the right ureter orifice there came no colored liquid. Röntgen examination of kidneys: Right kidney shadow is considerably smaller than that of the left, and has an irregular lobate form; its greatest breadth is about  $5\frac{1}{2}$  cm. No calcification demonstrable within it. Here there occurs an evident shrinking of the right kidney and, probably, a compensatory hypertrophy of the left. After examination September 17, 1923, the patient is still without any urination troubles. Increased 13 kilogrammes in weight. Urine clear, without any other pathological constituents than a few white blood-corpuses. Right kidney palpable; appears to be enlarged. Left kidney not palpable.

## RENAL TUBERCULOSIS

Here, then, we have a case of a woman, twenty-seven years ago, when twenty-four years old, previously healthy, gradually displayed symptoms of urinary affection, which, on examination about a half year later, proved to be renal tuberculosis, probably right-sided. No catheterization of the ureters is undertaken, but, from the clinical symptoms—right-sided pains in the kidney, and a palpable, enlarged right kidney—the assumption of a right-sided localization is plausible. After about one month's lunar-caustic-lavation of the bladder, the patient is discharged from the hospital, an operation having been declined by her. After a couple of months more, but without treatment, all symptoms disappear forever. On examination, twenty-seven years after the beginning of the sickness, the patient is still free from all subjective urinary troubles; the urine is perfectly normal, with the exception of a small number of pus-cells in the sediment and a similarly relatively innocent colo-infection in the urine. A cystoscopic examination shows the bladder to be normal; the right ureteral orifice cannot be discovered, however, and no urine is obtained from the right kidney on a function-test with indigocarmine. The right kidney is still palpable and somewhat enlarged. A röntgen examination shows in the place for the right kidney a dense shadow of the shape of a kidney, but of somewhat larger dimensions. The guinea-pig test for tuberculosis is negative in the urine.

Are we here entitled to speak of a genuine spontaneous healing of the kidney tuberculosis? The observation-period is long; twenty-seven years. All subjective troubles have disappeared. The disappearance of the tubercle bacilli from the albumen-free urine is demonstrated by animal-test. But there is no proof that the previously tuberculous kidney has retained its powers of functioning. On the contrary, the result of the examination now seems to point to that kidney having altogether ceased to act. Consequently, everything seems to point to our having a case of so-called *autonephrectomy*, where the diseased kidney, after a greater or less destruction of the parenchyma of the kidney, has been cut off from communication with the bladder by a cicatricial stricture of the ureter, whereby the further spread of the tuberculous process into the urinary system has been prevented.

As such a closed, but not in the real sense of the term, healed kidney formed a constantly present danger of the spread of tubercles (Wildbolz<sup>14</sup>), an operation was proposed to the patient (nephrectomy) but she refused to submit to it. The final and conclusive evidence that we have here a case of autonephrectomy—an anatomo-pathological examination of the extirpated kidney is, consequently, impossible to obtain.

(2) Male, fifty-one years old (1.559/1919). Diagnosis: *Tbc. ren. sin.* Ever since 1906, increasing urinary troubles; more frequent desire to urinate, even at night smarting pains in the urethra at the beginning and close of urination, and cloudy and albuminous urine. The trouble continually increased to such a degree that the patient, during the last few years before admittance to the hospital, had been obliged to urinate 3 or 4 times an hour, both night and day. On several occasions there was much blood in the urine, partly diffuse, partly coagulated. Some sense of fatigue, but no diminution in weight. No pains in the kidneys. Latter, subjectively somewhat improved. Admitted June 2, 1919. Status: Good general condition. Kidneys not palpable nor tender. In urethra, 15 cm. behind its orifice, a 3 cm. long, relatively slight stricture. In the peri-

## MAURITZ PERSSON

neum, corresponding to the place of the stricture, there is palpated a somewhat thickened and hardened part of the urethra, not tender to the touch. Prostata and exterior genitalia, in other respects without remark. Urine somewhat cloudy and acid. Heller's test positive. Large numbers of pus-cells, but few red blood-corpuses in the sediment. Tubercle bacilli demonstrated. Guinea-pig test for tuberculosis positive. *Cystoscopic examination:* The bladder receives with tension 100 c.cm. Right ureteral orifice soft and thin-walled. Catheter introduced into the right ureter as far as up to the rectal pelvis. In the left ureter, the catheter met with an obstacle 2 cm. from the orifice. No urine was obtained. The urine from the right ureter almost clear; acid. Heller's test positive. In the sediment a few pus-cells; a larger number of red blood-corpuses; a few tubercle bacilli. As bilateral kidney tuberculosis was considered to exist, the patient was discharged unimproved June 17, 1919. After returning home, the patient at first grew worse. He could not retain his urine more than 10 minutes at a time, either day or night. Was unable to work. Late in the autumn of the same year, he began to slowly grow better. His strength gradually returned; at night he could retain urine for an hour; the urine grew clearer after having previously been of a milky-white; the painful desires to urinate diminished. During the following years, grew better and better; the urine became perfectly clear; the frequency of urination diminished to the normal, and the patient felt perfectly well and could resume his work to its full extent. On a post-examination, April 11, 1924, the patient appeared to be in very good general health; flesh ordinary (increased 9 kilogrammes), muscular system vigorous; good appetite; in a word, subjective health. Kidneys not palpable nor tender. Prostata and seminal vesicles without remark. In the right cauda epididymitis a slight induration. The urine crystal-clear, acid. Heller negative. In the sediment no white or red blood-corpuses or cylinders; no tubercle bacilli or other bacteria. *Guinea-pig test for tuberculosis positive.* Cystoscopic examination was declined by patient, as he felt perfectly well. Röntgen examination of kidneys showed no evident alteration of the kidney-shadows.

A man, thirty-eight years of age, thus gradually falls ill with urinary troubles; frequent desire for urination, smarting in the urethra in urination; cloudy urine, sometimes blood-colored. The illness continues with certain variations in intensity, which, on the whole gradually increases, for thirteen years, after which the patient is admitted to the surgical clinic. Pus-cells and tubercle bacilli are demonstrated in the urine. On cystoscopic examination there are found slight alterations of the bladder and diminished bladder-capacity. In the left ureter a hindrance 2 cm. above the orifice; no urine from the left side. The right ureteral orifice normal. In the urine from the right side a few pus-cells and a very few tubercle bacilli. It was assumed that it was a case of bilateral renal tuberculosis, and the patient was discharged without a request for operation being addressed to him. Some months after the patient's returning home there begins a continuous improvement of all subjective troubles without any treatment of the complaint. After about a year, the patient is subjectively perfectly restored to health. After about another three years of subjective health the patient feels himself perfectly well, and the urine is in all respects normal. The guinea-pig test gives, however, undoubtedly a positive result.

Although in this case, all trouble has ceased for a relatively long time and the urine has become clear, free from albumin, pus-cells and microscopically demonstrable tubercle bacilli and other bacteria, it is evident that we

## RENAL TUBERCULOSIS

cannot here speak of a spontaneous healing of the kidney tuberculosis. Apart from the fact that here is no evidence that the previously diseased kidney has resumed its functions, the positive guinea-pig test shows, on a post-examination that the tuberculous process in the urinary organs is not cured. In this instance, too, the most likely explanation of the patient's subjective and apparent healing is an enclosure of the diseased kidney before any considerable alteration of the bladder had taken place, or, at any rate, not more than that it could be healed after such an enclosure of the affected kidney. Although, on the post-examination being made, the patient refused to submit to a cystoscopic examination, still, from the absence of albumin and white blood corpuscles in the crystal-clear urine, we are, most probably entitled to suppose that there now exists no alteration of the bladder. It is impossible, however, to express an equally well-founded epicritical opinion respecting the case. It seems to be most probable that the left kidney has always been, and still is, tuberculous. Possibly it is undergoing autonephrectomy, and that the ureter catheter find from the right kidney in 1919, which was interpreted as positive, was the result of an incorrect deduction (cf. Wildbolz's opinion, 1913<sup>14</sup>: "Es können aus der infizierten Blase Tuberkelbazillen in den gesunden Ureter verschleppt werden; das beweisen merere in der Literatur mitgeteilten Beobachtungen").

### IV. POST-INVESTIGATION OF OPERATED CASES

The indications for operative treatment that have been followed have, as a rule, been that which are now generally acknowledged by surgeons; *viz.*: nephrectomy in every case of unilateral, chronic kidney tuberculosis, where the kidney of the other side can be considered as functioning sufficiently, and where there is an absence of definite contra-indications. Independent of exploratory operations, 205 cases have been subjected to operation; nephrotomy in seven instances and nephrectomy in 198.

*A. Nephrotomy and Kidney Resection.*—These seven cases belong to the earliest among the material. In three there were present great pyonephrosis, and in one a rather large perinephritic abscess. The condition of the other kidney was not known with certainty. In one instance, with tubercle bacilli and pus-cells from the one kidney, and healthy urine from the other, the kidney on operation was found macroscopically normal both on the surface and on section being cut through the kidney. The kidney was therefor allowed to remain after the pelvis had been drained. In two instances, finally, the macroscopic alterations were restricted to a few small granules in the upper pole of the kidney which were removed by resection. Result: 6 died within five years after the operation; one is still alive, 16 years after operation, and feels perfectly healthy. A post-examination made by the writer gave no signs of any disease of the urinary channels (the patient refused to submit to cystoscopic examination, however). This was the same case where, as remarked above, the macroscopically normal kidney was left, so that, to a certain extent, this case is dubious. Experience does not nullify Wildbolz<sup>14</sup> opinion with respect to nephrotomy in the case of kidney tuberculosis: "Die ab und zu durch diesen Eingriff erzielten Besserungen des Leidens waren nie von langer Dauer; immer nahm der tuberkulöse Prozess in der Niere nach kürzer Pause seinen Fortgang."

*B. Nephrectomy. a. Bilateral kidney tuberculosis.*—The indications for nephrectomy in bilateral kidney tuberculosis are scanty. Ekehorn<sup>5</sup> considers that the kidney most

attacked should be removed if, by its presence, it is evidently injurious to the patient (*e.g.*, in the case of pyonephrosis and toxin-resorption, great pain and repeated haematuria), and this even if the tuberculosis in the other kidney is not in an early stage. This if the condition of the patient, in other respects, allows of this being done. Kidney-insufficiency need hardly be feared as the healthier kidney has already been undertaking most of the work of the diseased one. Braasch<sup>2</sup> is of a somewhat divergent opinion: "Unless one kidney is largely destroyed and the other is in fair condition, operation should not be considered; and then only when infection, pain, or possibly hemorrhage renders it imperative." Wildbolz<sup>14</sup> is extremely sceptical as regards operation in the case of bilateral, although he considers it justified under certain circumstances.

The result of our cases of nephrectomy in bilateral renal tuberculosis is not calculated to encourage extended indications for operative treatment. Eight patients with bilateral renal tuberculosis have been operated on during the years covered by the investigations, and the eight patients have died, all within two years after the operation; two from miliary tuberculosis, 1½ and 16 months, respectively, after the operation (autopsy); one of general tuberculosis and amyloidosis 5 months after the operation (autopsy); one with extensive pulmonary—laryngeal—intestinal and bladder tuberculosis and pelvic and perineal abscess 3 months after operation (autopsy) and, finally, four from general cachexia and uremia from 7 months to one year and 10 months after operation.

b. *Unilateral Renal Tuberculosis.*—1. *Operative mortality.* It is clear that, within a fixed material, this will vary according to the length of the period which has been fixed as the limit between operative mortality and late mortality. This period has, in the literature, been stated very differently, and varies between one and six months after operation. Israel,<sup>7</sup> for instance, gives for a collected material of 1023 cases an operative mortality within six months of 12.9 per cent. He considers the deaths within six months to be the result, for the most part, either directly or indirectly, of the operation. Acute miliary tuberculosis, for instance, which during this period appears in almost twice as many cases as in the total of the following years, should, consequently, be the result in most instances of careless manipulation of the kidneys, or of the operation-wound becoming infected by the contents of a tuberculous abscess. Wildbolz,<sup>14</sup> on the contrary, states that the endovesical examinations preceding the operation should bear a part of the blame for appearance of acute miliary tuberculosis, especially in consequence of lesion of the tuberculous seats which often occur in *pars posterior urethrae*. In support of this opinion we have the fact that the greater number of the post-operation miliary and meningeal tuberculoses attack men. Among 445 cases of nephrectomy, Wildbolz observed an operative mortality within six weeks of 2.4 per cent.

Braasch,<sup>2</sup> with 2.9 per cent.; Crabtree and Cabot,<sup>4</sup> with 3.8 per cent., and Lower and Shupe,<sup>10</sup> with 2.3 per cent. operative mortality include therein the deaths occurring within the hospital where the patient is under observation, independently of the space of time that has elapsed since the operation. Kümmell,<sup>9</sup> following the same rule, reports 7 per cent. operative mortality.

It seems to the present writer that the most correct way is to follow the last-mentioned method of calculation. The fixing of a certain period would allow all too many possibilities for unforeseen contingencies. As a matter of fact, however, all the deaths in our material that took place within six months

## RENAL TUBERCULOSIS

after the operation happened while the patients were still at the hospital, with the exception of one who died of miliary tuberculosis seven weeks after being discharged. This makes the operative mortality almost identical whether we adopt Israel's method of calculation, or that of Braasch and the others.

The size of the various mortality-groups is seen by the following table:

Operations for unilateral renal tuberculosis .....	190	
Operative mortality .....	14	7.3%
Patients with complete post-operative data .....	182	
Died after discharge from the hospital .....	45	24.7%
Of these, within three years after operation .....	21	
later than three years after operation .....	24	
During the 1st year after operation .....	5	
During the 2nd year after operation .....	9	
During the 3rd year after operation .....	7	
During the 4th year after operation .....	4	
During the 5th year after operation .....	4	
During the 6th year after operation .....	6	
During the 7th year after operation .....	2	
During the 8th year after operation .....	1	
During the 9th year after operation .....	1	
During the 11th year after operation .....	2	
During the 14th year after operation .....	2	
During the 16th year after operation .....	1	
During the 18th year after operation .....	1	

The operative mortality calculated for all the thirty years embraced by the investigation, amounts, consequently, to 7.3 per cent. Various writers have pointed out, however, that the operative mortality has shown a great tendency during the last few years to sink, as both diagnoses and operative technics grow better. During the last five years included in the present writer's investigations, there have been carried out 85 cases of nephrectomy for unilateral renal tuberculosis, with an operative mortality of 4 cases, or 4.7 per cent.

These figures appear relatively high compared with those of Braasch, Crabtree and Cabot, and with the statistics given by Lower and Shupe,<sup>2, 4, 10</sup> but it must be remarked that, in general, the patients have had to remain a fairly long time at the hospital after the operation. Only one patient died within six months after the operation after discharge from the hospital. Within the lapse of one year after operation, only four more patients had died. These five deaths within the first year constitute 11.1 per cent. of the late mortality. For the sake of comparison there are given the corresponding figures from Braasch's investigation<sup>2</sup> which, after the deduction of the operative mortality, amounts to 52 per cent. of the late mortality.

The operative mortality among men is considerably greater than that among women, the figures being 9.5 per cent. and 4 per cent., respectively.

*Causes of Death in Operative Mortality.*—In two instances uræmia, five and two days, respectively, after operation. In neither instance had ureteral catheterization been carried out. Both cases belonged to the very earliest

MAURITZ PERSSON

within the material, and no similar instance has occurred since. In the one case autopsy showed an almost complete aplasia of the second kidney, and, in the second, thrombosis of vena renalis on the healthy side. Wildbolz<sup>14</sup> points out that the post-operative uremia during the last few years has diminished so greatly in frequency that it is scarcely necessary to take the danger of such a complication into calculation if, before nephrectomy, it is possible to carry out a searching examination of the patient. In 1913, out of 175 cases of nephrectomy, he had but one instance of uremia; in 1921,<sup>15</sup> out of 270 fresh cases, not a single one.

In 5 cases tuberculosis in one form or another was the direct cause of death; *viz.*, acute miliary tuberculosis in two instances (one man and one woman, who died two to three months after operation), pneumonia caseosa in two instances, and peritoneal and intestinal tuberculosis in one. In all the cases except one, autopsy was made. In this last instance, miliary tuberculosis was found by means of Röntgen examination of the lungs.

In two cases acute pneumonia, and in three, heart complications, were considered to be the cause of death (autopsy). In one case there appeared a duodenal fistula in the operation wound and the patient died of inanition two and one-half months after operation. Finally, cause of death in one case, two weeks after operation, was retroperitoneal phlegmon, starting from a rather large abscess in operation wound, which in spite of incision and drainage from lumbar incision, dissected itself down along ureter to the pelvis and perineum.

2. *Late Mortality*.—No case has been observed a shorter time than three years after operation. In this respect this analysis differs from most of the others in this question. One year is, the writer thinks, all too short a period to allow a reliable opinion being passed with respect to late mortality. According to Israel,<sup>7</sup> about one-half of the cases of late mortality occur within *two* years after operation. The present writer's examinations go to show that about one-half occur within the first *three* years. Three years, therefore, appear to him to constitute a suitable minimum observation period. Seven of the cases of late mortality occurred within the last two years of the three-yearly observation period—in 1922, 1923. Had the examination been carried out two years earlier, *i.e.*, with only one year's observation time, the late mortality would have been 4 per cent. less. In Israel's collected statistics, the total mortality was about 25 per cent., but he remarks that this figure should, in reality, be larger, for, of the numerous cases that have been under observation only for a short period, many die later on. Like Israel, the present writer neglects the accidental cases of death, which are not connected with the fundamental affection, and which are four in number: One of *cancer mammae*, thirteen years after nephrectomy (on post-examination at the Seraphimer Hospital, nine years after nephrectomy, the patient had been considered to be cured of affections of the urinary organs); one of *cancer ventriculi*, twelve years after nephrectomy (examined here five years after the operation and then found well); one of *vitium cordis incompensatum*, seven years after nephrectomy (slight incompensation already at the time

## RENAL TUBERCULOSIS

of operation; two years after operation, the post-examination showed no signs of tuberculosis of the urinary organs, the guinea-pig test not carried out, however), and, finally, one of *ulcus ventriculi*, eleven years after operation, after which the patient had been subjectively perfectly free from all tuberculosis of the urinary system for several years.

The late mortality, therefore, embraces all the cases of death after discharge from the hospital and temporary improvement subsequent to the operation—caused by tuberculosis in various organs or by disease in the remaining kidney, inclusive of the non-tuberculous. Of the 182 cases with exact post-operative data, 45 are dead, *e.g.*, 24.7 per cent. late mortality. Of these, 31 were men and 14 women. Late mortality, like operative mortality is greater in the case of men than in that of women, or 28.4 per cent. as against 19.2 per cent., respectively. This is, probably, connected with the relatively common occurrence of genital tuberculosis in men, as shown above.

*Causes of Death within Late Mortality.*—There are essentially three great groups of diseases causing the death of nephrectomized patients at a later stadium, when the operating trauma must be considered as having ceased to act as a contributory cause of death. They are: *diseases of the remaining kidney*; *pulmonary tuberculosis* and *miliary tuberculous processes*.

<i>Died within four years</i> .....	24
Of which, of disease in remaining kidney .....	12
of pulmonary tuberculosis .....	7
of miliary tuberculosis .....	5
<i>Died after four years</i> .....	21
Of which, of disease in remaining kidney .....	9
of pulmonary tuberculosis .....	9
of miliary tuberculosis .....	1
of spondylitis with paraplegia .....	1
of peritoneal tuberculosis .....	1

The largest group consists of *diseases of the remaining kidney*, *i.e.*, 44.4 per cent. of the cases of the late mortality. In Israel's collected statistics<sup>7</sup> the corresponding figure was 40.5 per cent. In one instance the cause of death was nephrolithiasis. The patient had survived nephrectomy sixteen years and was perfectly cured of his renal tuberculosis, this being demonstrated at the hospital here by examination seven years after operation. In the remaining 20 cases, the cause of death was urogenital tuberculosis. In four of these instances it seems probable that a new, haematogenic infection of the previously healthy kidney had arisen several years after nephrectomy, for, by a complete cystoscopic examination and ureteral catheterization, it had been demonstrated before the operation that the urine from the other kidney had been healthy and without tubercle bacilli and pus-cells, and that, in two of the cases, the bladder alterations had been confined to a limited redness and swelling and, in the other two instances, to a very few miliary granules or ulcers, respectively. Three of the cases were operated on in 1910 and 1911. On post-examination in 1913 there remained in them no other symptoms than a somewhat increased desire to urinate. There was no albumin in the urine,

and no pathologic sediment. The alterations in the bladder were perfectly cured. Later on there appeared increased symptoms, and the patients died in 1917, 1918 and 1921. In the fourth case, operated on in 1914, the patient was subjectively quite healthy for several years. In 1918 there was no albumin and no pathologic sediment. The bladder tuberculosis cystoscopically healed. Later on there reappeared typical symptoms, with mors, 1922, at another hospital, of kidney tuberculosis and uræmia.

In the other 16 instances it would seem more probable that the other kidney, if healthy on the occasion of the operation, had become infected from the bladder, the tuberculosis of which, instead of healing, had increased after nephrectomy.

In 2.2 per cent. of the nephrectomized patients, consequently, a new kidney tuberculosis seems to have appeared after operation. Israel's corresponding figure was 1.6 per cent.

*Pulmonary tuberculosis* has been the cause of death in 35.5 per cent. of the cases. Israel's<sup>7</sup> corresponding figure is 43.2 per cent. The greater mortality caused by kidney tuberculosis as compared with pulmonary tuberculosis is combated by Wildbolz, 1913,<sup>14</sup> when he states that he has only once observed tuberculosis in the second kidney as the cause of death, and that the absolutely greatest part of the late mortality is due to pulmonary tuberculosis. On renewed post-examination of 125 cases ten years after the first,<sup>15</sup> it proved, however, that, of the 104 instances of which he had succeeded in obtaining information, 40 had died (in addition to the operative mortality of four cases) within the course of the following years; *viz.*, 14 of urogenital tuberculosis, "mostly tuberculous disease in the secondary kidney"; 13 of pulmonary tuberculosis; 6 of meningitis; 1 of tuberculous peritonitis; 1 of spondylitis, and 5 of intercurrent illnesses. On the whole, therefore, in Wildbolz's statistics, too, diseases of the second kidney have proved to be a threat to the future health and life of the nephrectomized patients in quite as high a degree as pulmonary tuberculosis.

The *miliary tuberculous processes* come third, with 13.3 per cent. Israel's corresponding figure<sup>7</sup> was 13.2 per cent. Of the six cases in the present writer's material, two occurred in the first year, one in second, two in fourth and one in sixth after operation. Three were men and three women.

In one instance, the cause of death was spondylitis, the existence of which was manifest already when the operation was performed; it afterwards increased and caused death fourteen years later, in the shape of a paraplegia, paresis of the bladder and cystopyelitis non-tuberculosa. Finally, in one case, death was caused by *peritoneal tuberculosis* three years after operation, and subsequent to a considerable improvement of the symptoms from the urinary organs. On the occasion of the operation, there had been found cystoscopically in the bladder only a single granule in the vicinity of one of the ureteral orifices. In the urine from the healthy kidney no pus-cells had been found, and the guinea-pig test there had given a negative result.

3. *The Condition of the Survivors.*—As the requirements that should

## RENAL TUBERCULOSIS

be put forward in order to obtain a satisfactory definition of the expression, "a definite cure of renal tuberculosis by nephrectomy," are given so differently by different writers, it is extremely difficult, in the individual case, to give a definite opinion in this respect; above all, as regards the patient's prospects for the future. Wildbolz<sup>14</sup> says in this respect:

"Der Schwund der Krankheitsbeschwerden und das gute Befinden des Kranken geben noch nicht die Berechtigung, an Heilung zu glauben. Es muss erst erwiesen sein, dass der Urin eiter—und bazillenfrei geworden ist. Aber auch dann darf noch nicht von definitiver Heilung gesprochen werden, bevor diese Besserung des Zustandes des Kranken längere Zeit, mindestens 3 Jahre lang angedauert hat und auch alle ausserhalb der Harnorgane gelegenen Tuberkuloseherde geheilt oder wenigstens latent geworden sind. Nicht alle Chirurgen stellen an den Begriff der Heilung die gleich strengen Anforderungen und es ist deshalb auch nicht möglich, die mitgeteilten Statistiken über die Dauerheilungen der Nierentuberkulose in einer einheitlichen Sammelstatistik zu vereinigen."

In an analysis of the present kind, it is, for practical reasons, probably impossible to make such strict conditions for the definition, "cure." In scarcely one-half of the surviving cases has it been possible for the present writer to make a personal examination, and, for the remainder he has had to be satisfied with written replies to the question-form sent to the persons in question. In most instances, statements of patients respecting their subjective condition, are supplemented by examinations of the urine by doctors.

*Recovered.*—As "well" have been put down those patients who, three years or more after operation, have been found free from troublesome desires to urinate\*; smarting pains on urination†; considerable pyuria‡ and haematuria,|| and who have, besides, almost totally regained their strength and power to work ¶ and, finally, have increased in weight.§

In addition, the requirement has been made that no sign of tuberculosis

\* In 66.1 per cent. of the survivors, with frequent urination before operation, this symptom still continues; in one-half the cases, however, so slightly as one urination nightly. In 12.6 per cent. the frequency is more than twice nightly. In 33.9 per cent. there is no urination at night.

† In 82.2 per cent. of the survivors, there occurs no smarting on urination. In 17.8 per cent. the smarting still continues, but of these, in only one-seventh of the cases is the symptom constant.

‡ Seventy-nine per cent. of the survivors have perfectly clear urine. About one-half have been examined personally. In 54 per cent. of these latter cases, white blood-corpuscles have been microscopically demonstrated in the urine; in two-thirds of these cases, however, only a few have been observed. In one-third of the cases with pus-cells, coli-infection was observed at the same time.

|| In 74.5 per cent. of the survivors there has never occurred macroscopically admixture of blood in the urine after discharge from the hospital. In 17 per cent. it occurred soon after the patient's return home. In the other 8.5 per cent. haematuria still occurs now and then.

§ Eighty per cent. of the survivors have reported themselves fully capable of work; 14.4 per cent. almost so, and 5.6 per cent. not capable of work.

¶ Seventy-seven and eight-tenths per cent. of the survivors have on post-examination been found to have increased in weight; about one-third of these by more than 10 kilogrammes; some as much as 30 to 40 kilogrammes. Nineteen and four-tenths per cent. have retained their weight. Two and eight-tenths per cent. have diminished in weight.

MAURITZ PERSSON

has made its appearance in other organs after the operation or, if such symptoms have shown themselves, that the tuberculosis in such instances has ceased. A return to completely normal frequency has not been demanded in the case of desire to urinate, but a definite and lasting, considerable improvement in this respect has been demonstrated in all instances. In Israel's<sup>7</sup> material, the frequency of urination became normal after nephrectomy only in 40.9 per cent., although 63.8 per cent. of the cases proved that they had healed, by the disappearance of the tubercle bacilli from the urine (guinea-pig test).

One hundred and four cases fulfil these requirements, corresponding to 57.1 per cent. of definite cures. The observation period has been:

In 2 cases 23-25 years	In 39 cases 5-9 years
In 11 cases 15-20 years	In 16 cases 4 years
In 26 cases 10-14 years	In 10 cases 3 years

*Improved.*—In 10 cases, or 5.5 per cent., an evident improvement of the condition has been demonstrated. The patients have become perfectly, or almost perfectly, capable of work; their weight has increased or remained unaltered. But the desire to urinate is still very frequent, and, in a number of cases, there still remains the smarting in the urethra after urination, and this several years after operation. In several cases, the urine is cloudy, and contains pus-cells, but no tubercle bacilli. In a couple of instances the urine is clear, but slight haematuria occurs every now and then. The periods of observation are:

In 1 case 23 years	In 1 case 9 years
In 3 cases 14 years	In 1 case 7 years
In 1 case 11 years	In 1 case 6 years
In 1 case 10 years	In 1 case 3 years

In all these instances it seems to be extremely probable that the tuberculosis of the urinary organs has ceased to develop, although, at the time of the operation, the alterations in the bladder had been so pronounced that it was impossible to arrive at any *restitutio ad integrum*.

*Unimproved and Worse.*—In 9 cases, or 5 per cent., the patients, on post-examination, have proved to be incapable of work; have frequent desire to urinate, painful urination, cloudy urine, containing pus-cells and, in the four cases personally examined, tubercle bacilli. In the seven instances the observation period has been less than six years, and, in two instances, seven and eight years, respectively.

4. *Operative Technics and Wound Healing.*—The treatment of the ureter and the operation wound (drainage or primary suture) has been the subject of much discussion in the literature. Kretschmer<sup>8</sup> gives a summary of the various opinions that have come into conflict in this matter: "The many different ways of treating the ureter which have been advised is proof that the ideal method has not been obtained." The question of the primary closure or drainage of the operation wound has been discussed by, *inter alia*, Crabtree and Cabot<sup>4</sup>: "It is interesting to compare the end-results of the drained

## RENAL TUBERCULOSIS

wounds of this series with that of our recent cases in which the wound was closed without drainage after injecting salt solution.\* In these latter cases there were 25 per cent. of the wounds that remained tight, while 75 per cent. developed abscesses. Abscess development was usually three to five weeks after leaving the hospital. This fact would have encouraged us to close all wounds without drainage had it not been our misfortune to follow the cases in the out-patient department and see the final results." Ekehorn<sup>5</sup> says, respecting this question: "For many years back (I should think almost ten), under ordinary circumstances I close the short wound in the wall of the abdomen completely, without drainage and without tamponade. It is healed in the shortest time without any reaction at all †. The best treatment of the ureter is to allow it to drop back into the wound. One shall not be eager to remove a long portion of it. I speak from experience, for I have tried other ways, too, of treating the ureter. Suture of the ureter to the skin is an inferior—nay, a bad method."

In the present writer's material there are 135 cases with exact statements respecting the treatment of the ureter and the wound, where the patient survived for a period sufficiently lengthy to allow of an opinion being formed respecting the result of the healing. All the patients have been followed for a period of three to twenty years, with the exception of a few who died within three years. In earlier years, the drainage method was practised consistently, whether the operation wound had been infected by abscess contents from the kidney or not. During the last few years, ligature of the ureter some few centimetres down the kidney pelvis has been consistently adopted, and burning off by thermocautery, whether the ureter there was considerably thickened, hardened and tuberculized, or not, and primary suture. In cases where any infection of the wound has taken place, the wound has been drained by means of a rubber tube which has been removed after one or two days.

In earlier years, some exceptions from the rule have been made. For instance, in four cases the ureter has been sutured to the skin, and, in another four, ureterectomy has been carried out, in three of them primarily, and in one, secondarily. The table at top of page 544 is meant to show the healing results under the different conditions.

On making a comparison between the results of the different methods that have been employed, it is seen at once, and without any percentage calculation of the table, that *ligature of the ureter and primary suture, is, from the wound-healing point of view, far superior to the other methods.* Of the 64 cases, the history of which has been followed during at least three years, with the exception of a very few who died before the close of that period, all have healed *per primam* within the course of two weeks, and in only two of these cases has any secondary abscess formation arisen—in the second and third months, respectively, after operation—*i.e.*, in striking agreement with Crabtree's and Cabot's experience,<sup>4</sup> that eventual secondary abscess formation

\* According to Mayo. Remark by the present writer.

† The majority of my primary, closed cases consists of Ekehorn's operation-material,

## MAURITZ PERSSON

	No. of Cases	Definite healing in a period of										No healing yet, after a time of								
		Months					Years					Months		Years						
		1/2	1	2	3	4	6	9	1	1 1/2	2	3	4	2	4	6	3	5	7	11
Ureter sutured to the skin.....	4													1 <sup>1</sup>					1 <sup>1</sup>	
Ureterectomy + drainage.....	3													1 <sup>1</sup>	1 <sup>1</sup>					
Ureter ligated, dropped + drainage....	64	6	12	4	5	3	15	1	6	2	4	1	2		1 <sup>3</sup>			1 <sup>2</sup>	1 <sup>2</sup>	
Ureter ligated, dropped + primary suture.....	64	62																		

(1) Dead. (2) Still living. (3) Then secondary ureterectomy, followed by healing in some months.

after primary suture usually appears in from three to five weeks after discharge from hospital. The one case was healed definitely, in another two weeks; the other in somewhat less than one year, after Röntgen treatment.

It should be noted, however, that, in the case of any infection of the operation wound by abscess contents from the kidney, complete primary closing has not been carried out. During the last few years, drainage has been done for one or two days in such instances by means of a fine rubber tube. It is these cases, together with the two clean ones, drained in the same way, which occupy a special position among the drained wounds, in so far as they were healed in two weeks. The drained cases, in other respects, where the drainage material has been allowed to remain for some longer time, or has been quantitatively larger (in a relatively large number of cases, Mikulicz's drain was formerly employed), have taken a period of from one month to four years for healing, where they have really been healed. In one instance, the patient still lives after having fistula for seven years, and, in another case, for eleven years.

Suture of the ureter to the skin appears to be a bad method, the earliest instance of healing occurring after three months. In one instance, the wound was not healed before two years and, finally, in another case, not even after the lapse of five years.

In ureterectomy, healing was obtained in one instance, three years after operation. In the others, the patients died with unhealed fistula, two and six months, respectively, after operation. In one case of drainage with very much secretion, secondary ureterectomy was carried out four months later, after which the fistula was healed during the course of some months. The relatively bad results in ureterectomy cannot be explained by the ureterectomy itself, but is probably connected with the drainage then adopted. It is a matter of course that the conditions of healing cannot very well be made worse by the removal of a large portion of the tuberculous ureter instead of allowing it to remain. But it is also clear that, in order to obtain a good wound healing, it is not necessary to carry out a total or subtotal ureterectomy,

## RENAL TUBERCULOSIS

for in none of the six cases in the table, with primary suture, had ureterectomy been undertaken, although, in a great number of instances, the ureter was thickened and rigid, evidently tuberculized, at, and also below, the place of burning off. No other measures for sterilizing that part of the ureter which was allowed to remain have been taken in the cases within this group than the thermocauterectomy of the mucous membrane after division between ligatures, after which the ureter stump has been allowed to glide back into its old position.

As a matter of fact, it is not so very wonderful if the best healing is obtained by means of primary suture, in spite of the tuberculous ureter which is allowed to remain. From a purely biological point of view, one might be able to draw a parallel between the conditions that arise on such a method of procedure and those that are found on the treatment of a tuberculous cold abscess, for instance, in a spondylitis. Such an abscess should, as we are taught by many years' experience, be treated conservatively, by, eventually repeated, puncture. If, however, it be incised and emptied then, in the most instances, we shall, of course, get the incision opening to heal quickly if primary suture be carried out immediately. If, on the other hand, this be neglected, we then obtain a fistula of long duration, difficult to heal, and with secondary infection. Another thing is the danger of secondary tuberculizing or delayed healing of the bladder which that part of the ureter which is left would cause by the continued transport of infectious material to the bladder. The number of ureterectomy cases in the present writer's material is too small to allow of any conclusive examination of the final results in comparison with those obtained by other methods. But it appears to him improbable that any considerable transport of infectious material occurs in the most cases after nephrectomy. The tendency to ulcerative decomposition is, of course, considerably much less in a tuberculous ureter than that in a tuberculous kidney. "Post-mortem examinations of the stump after nephrectomy have shown that the ureter has undergone atrophy and been converted into a hard, fibrous cord." (Kretschmer.<sup>8</sup>)

In this connection, it is of interest to cite some words respecting the question touched upon above, uttered long ago by Berg<sup>1</sup>: "A good and fresh illustration of the almost diametrically opposed opinions entertained by different surgeons is the interesting discussion at the New York Surgical Society during its meeting on January 25, this year (1899). Most of the speakers on that occasion, however, were inclined to think that, as a rule, the ureter should be left untouched on the removal of the tuberculous kidney, experience having shown that Nature attends to its healing, if only the kidney be excised."

5. *Bladder Tuberculosis; its Prognostical Importance in Operated Cases.*—In deciding this question it has seemed important to the present writer to neglect those cases that have been classified as immediate or operative mortality, and this because the operation trauma, as such, many times, perhaps, by some accidental circumstance, may have been able to diminish the value of the deductions that otherwise might have been drawn from the material.

MAURITZ PERSSON

In addition, those cases are excluded where exact post-operative data are wanting, and also, of course, those instances where it has not been possible to obtain sufficient, exact details respecting the condition of the bladder. In the total of 152 cases of nephrectomy where the patient survived six months after the operation, it has been possible to obtain the necessary data; in most of the cases by cystoscopic examination. Only in one or two instances was the extension of tuberculosis of the bladder demonstrated on autopsy, the irritability of the bladder having prevented cystoscopic examination, and in one case on *sectio alta* for the same reason.

Alterations of the bladder have been divided into three grades, according to character and extension. *Grade I* embraces those cases where macroscopic alterations in the appearance of the mucous membrane of the bladder are absent, or is restricted to redness and swelling of, or around, one ureteral orifice, or to some few miliary tubercle granules, and also those cases where the mucous membrane of the bladder displays diffuse, non-specific cystic alterations (redness and not excessive swelling). *Grade II* includes those cases where ulcerations of tuberculous appearance exist at one ureteral orifice or in its immediate surroundings, possibly in combination with miliary tubercle granules, all to a relatively restricted degree. *Grade III*, finally, embraces those cases with extensive ulcerations of tuberculous appearance in the bladder, either, large, crater-shaped, or small ulcerations, spread diffusely over the whole of the mucous membrane of the bladder. The following table is intended to illustrate the end-results under various conditions caused in the different cases by the different grades and extension of the bladder tuberculosis:

Alterations of bladder	No. of cases	No. of deaths	Per cent. of dead	Causes of death			
				Disease of remaining kidney	Pulmonary tuberculosis	Miliary tuberculosis	Intestinal tuberculosis
Degree I.....	83	11	13.2	4	7	—	—
Degree II.....	61	23	37.7	11	6	5	1
Degree III.....	8	6	75	5	1	—	—

Although these figures are relatively small, they seem, however, to show that the degree of tuberculosis of the bladder is of no slight importance in judging of the final result. Late mortality thus shows a great rising tendency in the higher grades of alterations of the bladder, it being nearly three times greater in ulcerating alterations of medium grade (II) than where there is no, or but little, alteration of the bladder (I), while it is about five times greater in the cases with extensive ulcerations of the bladder (III).

The causes of death exhibit another interesting circumstance. In the group of no, or little, alterations of the bladder (I) it is shown that nearly twice as many patients have died of tuberculosis of the lungs as of disease of the remaining kidney. Within Group II, the condition of things is just the opposite. In Group III, the figures are so low that one does not venture

## RENAL TUBERCULOSIS

to ascribe any considerable importance to them, but, still, they point in the same direction, the increase in the number of deaths from kidney diseases, being as 5:1 as compared with the deaths from pulmonary causes. In other words: When there is no, or but little, alteration of the bladder, there die about 4.8 per cent. of the patients in continued disease of the urinary organs; in non-extensive ulcerating alterations of the bladder, the figure rises to about 18 per cent., and in very extensive alterations of the bladder to 62.5 per cent.

In both these moments: increasing mortality and increasing relative mortality from kidney disease, we find an evident guide for our therapy; in unilateral, chronic renal tuberculosis: nephrectomy as soon as possible, before all too extensive alterations of the bladder have had time to make their appearance.

6. *Pregnancy and Delivery in Nephrectomized.*—Experience seems to show that, women, otherwise healthy, who have been nephrectomized, are, in respect to pregnancy and parturition, just like fully normal women. Wildbolz<sup>14</sup> says with regard to this: "Die Einnierigkeit scheint werder auf die Schwangerschaft noch auf die Geburt und auch nicht auf die Stillfähigkeit einen schädlichen Einfluss zu haben." Theodor<sup>15</sup>: "Einnierige Frauen überstanden eine Schwangerschaft in weitaus den meisten Fällen genau so wie Zweiingerige."

Of the 62 nephrectomized women in the present material who were of an age for conception, 10 have, after operation, given birth either once or oftener to a total number of 17. Of these, 9 have given birth to a total of 14 fully developed living children and to one fully developed stillborn child. In last instance, both nephrectomy and, four months later, secondary ureterectomy, had been carried out during gravidity. All these 9 women are now healthy and have no traces of albuminuria, and no urinary troubles of other kinds either. (In two cases, however, transitional albuminuria has been found in connection with parturition which, in all the cases, has, in other respects, been fully normal.)

One case, on the other hand, has presented a course altogether different from the other instances. It is a case where a serious degree of eclampsia developed itself during the second pregnancy after nephrectomy. And still we are probably able, with the highest degree of certainty, to exclude tuberculosis in the remaining kidney. As this case may possibly arouse a certain attention, its history is given below:

Woman, twenty-two years of age. II.613/1915. Diagnosis: *Tuberculosis ren. dxt.*—In 1914, gradually increasing urgency. March, 1915, slight haematuria June; aching in the loin; smarting on urination and cloudy urine. Admitted July 10. Good general condition. Lower pole of right kidney palpable and tender. Urine very clouded and slightly acid. One and three-quarters per cent. albumin; masses of pus-cells and red blood-corpuscles and tubercle bacilli. *Cystoscopic examination:* In right ureter, the catheter enters only one cm. and no urine obtained. Left urine clear. Heller's test negative. A few white blood-corpuscles and epithelial cells. No tubercle bacilli. Operation July 21: *Nephrectomy* of the right kidney. Drainage. Anatomo-pathological diagnosis: Tuberculosis.—After operation diminishing albuminuria to only traces, after which increased

## MAURITZ PERSSON

amount to one-half of one per cent., and a few granular cylinders. After wide opening of abscess in operation-wound September 28, again diminishing albuminuria. Discharge healed October 15. The patient afterwards felt better and better and married a couple of years later. Became enceinte during 1919, for the first time. In November, 1919, no albumin in urine. In January, 1920, albuminuria was discovered, and the patient was admitted to the Maternity Hospital on January 23. The swellings in the hands and feet and albuminuria; epithelial cells and a few cell-cylinders, but no white blood-corpuses in the urine. Spontaneous partus without complications. February 13. Fully developed, healthy child. February 15, amount of urine, 1800 c.cm., two-tenths of one per cent. albumin; February 16, 1700 c.cm. and one-tenth of one per cent., respectively; February 18, trace of albumin. Blood-pressure 170/120, falling to 155/115 mm. Hg. No other symptoms of eclampsia during stay in hospital. Discharged February 22, with trace of albumin in urine, but otherwise quite well. Afterwards subjectively healthy until close of 1923 when the patient was once more pregnant and began to be troubled with headache. Albuminuria occurred in increased degree. Admitted to Maternity Hospital, January 22, 1924, when in 8th month of gravidity. A few white blood-corpuses, but no red ones in urine. Blood-pressure 150/100 mm. Hg. February 15, visual flickering; twelve per cent. albumin; blood-pressure 160/110 mm. Hg. Visual sharpness diminished to 1/60. Anti-eclamptic treatment according to *Stroganoff* was begun. February 16, increased visual flickering. Non-protein nitrogen in blood 35.5 per cent. (according to *Folin*). Blood-pressure 200/140 mm. Hg. Pronounced retinitis albuminurica. After venæsection (450 c.cm.) the patient felt subjectively relieved. At 7 p.m. partus provocatus (egg-membrane sticking). February 17, at 3 a.m. labor-pains began. 4 p.m. partus. Living man-child, 45 cm. long. After partus, improvement, diminishing albuminuria (after one month, two per cent. albumin) and blood-pressure (135/90 mm. Hg.). On discharge, April 6, one per cent. albumin and white blood-corpuses still present in urine; considerably improved visual sharpness. Remainders after retinitis albuminurica. After examination May 4, 1925: Patient feels subjectively well. Sometimes, however, headache. Never œdema. Blood-pressure 150 mm. Hg. Frequency of urination 1-2 times nightly. Urine clear, acid. Hellers test positive (three per cent. albumin). In sediment a very few epithelial cells, white blood-corpuses and granular and hyaline cylinders. No red blood-corpuses, no tubercle or other bacilli. Non-protein nitrogen 41.1 mg. per cent. Eyegrounds display a certain degree of neurotic atrophy with blurred boundaries and pale color of the optic discs. Nothing pathological in macular regions.

We have, thus, here a case where, about five years after nephrectomy in connection with parturition, albumin appears in the urine, simultaneously with a moderate increase in the blood-pressure, but no other symptoms of eclampsia. The urine grows free from albumin but, in connection with a second pregnancy, about four years later, albuminuria and rising blood-pressure reappear; symptoms that relatively quickly increase to fully developed eclampsia with headache, visual flickering, and greatly diminished visual sharpness. The non-protein nitrogen remains normal. Labor is induced, after which the symptoms subside. The albuminuria percentage falls from 12 to 1 per cent., and the visual sharpness increases again in a considerable degree before the patient leaves the hospital, at the same time that the blood-pressure falls to about normal value. Now, one year after last parturition the patient presents 3 per cent. albumin, some slight increase of blood-pressure and remainders of optic neuritis. The non-protein nitrogen-value lies at the top of the normal, and the urine sediment displays some casts, like that in chronic nephritis.

## RENAL TUBERCULOSIS

The small number of cases of pregnancy and labor after nephrectomy for renal tuberculosis contained in the writer's material, is, consequently, not calculated to negative the earlier experience that women with one healthy kidney are equal, just in the same degree as fully normal women, to the increased demands on uroepic organs which are connected with the functions in question. But, in the above-mentioned instance with nephropathia gravidarum and eclampsia we have probably a case of *chronic glomerulonephritis* in the second stage (according to Volhard and Fahr). Possibly, the primary cause of this kidney disease lay in the formation of abscess in the operation wound, and the toxin adsorption thence. The first pregnancy has afterwards led to a deterioration in the condition of the remaining kidney (nephropathia gravidarum). During the second pregnancy, the condition has grown still worse, and has found expression as a typical eclampsia. The disease of the kidney has been of such a serious nature that a return to a normal condition has been afterwards impossible.

Thus it should seem as if a, from the beginning, very slight affection of the remaining, single kidney (the urine was even free from albumin at the beginning of the first pregnancy) under the influence of repeated gravidity could increase to such a degree that, within a few years it formed a serious threat to the health and life of the patient.

### V. SUMMARY

What has been said above may be summarized as follows:

We have dealt with a clinical material of 295 cases of surgical renal tuberculosis, 205 of which were subjected to operation. All the patients except 12 (8 of whom were operated on) were seen and examined again at a later date. The period of observation after discharge from hospital is, in every instance, not less than three years.

The material shows that the frequency of renal tuberculosis in men is almost twice that in women.

Hereditary tendency can be traced in 25 per cent. of the cases.

Almost two-thirds of the cases are patients in the third or fourth decades of their lives.

The cases of localization to the right kidney exceed those of the left (of operated cases: 109: 88).

Coincident tuberculosis in other organs has, according to the records, been shown in about only half of all the cases; pulmonary tuberculosis in 22.4 per cent.; genital tuberculosis (of men only), in 15.6 per cent.

Bladder irritability has been found as an initial symptom in 74 per cent. of the cases; pains in the kidney region in 18.5 per cent.; serious haematuria in 5.5 per cent. Succeeding symptoms have been: bladder irritability (a further 18.1 per cent.); macroscopic haematuria (in a further 45.2 per cent. of the cases).

Incontinence has occurred in 2.7 per cent. of the cases. This has been in

MAURITZ PERSSON

relatively advanced cases, but also without cystoscopically demonstrable ulceration of the bladder. Most evident in children and women.

The absence of albuminuria has been noted in 7 patients. Pyuria has never been absent. Tuberle bacilli have been demonstrated in 85.6 per cent. of the cases. Palpable kidney is noted in 25 per cent.; tender but not palpable in 9 per cent.

The extent and grade of the bladder tuberculosis seems to have exercised a considerable influence on the final result of the operated cases. In slight ulcerations of the bladder, the late mortality has been almost three times greater than when such have been absent (37.7 per cent. and 13.2 per cent., respectively); in extensive ulcerations, the mortality has been extremely great (of 8 patients, 6 have died).

*Post-examination of Non-operated Patients.*—Unilateral cases have shown a mortality (82.6 per cent.) which is but little less than in the whole of the examined non-operated material (84.5 per cent.), of which certainly almost half, and probably more, have been bilateral cases.

Already within five years after the clinical beginning of the disease, 63 per cent. of the non-operated have died, as a rule of urogenital tuberculosis, but, in some instances, of miliary tuberculosis and pulmonary tuberculosis.

It has been impossible to demonstrate spontaneous healing of tuberculosis of the kidney in a single case. One case, surviving twenty-seven years after hospital treatment, displayed so-called autonephrectomy. Another case, after seventeen years' observation, displayed subjective perfect freedom and microscopically perfectly normal urine; the guinea-pig test, however, was positive.

*Post-examination of cases treated by nephrotomy and kidney resection* exhibit no favorable result. All the cases with perfectly certain diagnosis (6 patients) were dead when the post-examination should be made.

Bad results are also shown after *nephrectomy in bilateral cases*. All the 8 patients died within two years after operation.

The total *operative mortality in nephrectomy for unilateral renal tuberculosis* amounts to 7.3 per cent. The corresponding figure for that half of the material latest operated upon—during the last five years—amounts to only 4.7 per cent. The operative mortality for men is more than twice that for women (9.5 and 4 per cent., respectively). The cause of death in two of the earliest cases in the material was *uraemia*, a complication which afterwards has not occurred for the last twenty years, although actual function tests from the different kidneys have never been made during this period.

The late mortality amounts to 24.7 per cent. Only 11.1 per cent. of the late mortality has occurred during the first year after operation; 46.6 per cent. within the first three years. Late mortality is considerably greater in the case of men than in women (28.4 per cent. and 19.2 per cent., respectively).

The total mortality is, consequently, almost twice as great as in the case of men as in that of women (40.3 and 23.3 per cent., respectively).

Forty-four and four-tenths per cent. of the late mortality deaths were caused by disease—tuberculosis in every case but one—of the remaining

## RENAL TUBERCULOSIS

kidney. In 35.5 per cent. the cause of death has been pulmonary tuberculosis; in 13.3 per cent. miliary tuberculosis.

*Fifty-seven and one-tenth per cent. of all the operated cases are, on post-examination, healthy; another 5.5 per cent. exhibit an evident improvement.* Of these latter, one-half have lived more than ten years after the operation. Only in one case of one-third of the 57.1 per cent. healthy cases has the urination frequency become completely normal, however.

Five per cent. of all the operated patients are worse, but still alive. Four of these 9 patients have, on personal examination, shown tubercle bacilli in the urine.

The best possible operation wound healing appears to have been secured by ligation of the ureter and burning it off by thermocautery below the kidney pelvis, and allowing the stump to drop back, and, finally, primary suture of the wound. Abscess formation has occurred in only 2 of 64 cases treated in this way, all of which were followed for a long time after operation. Equally good healing has been obtained, however, in 4 cases where, after infection of the wound from the abscess contents, a little draining tube has been inserted for the next day or two after the operation.

Women, *otherwise healthy*, who have been nephrectomized for renal tuberculosis, can go through pregnancy and parturition just as well as normal women.

But, on the other hand, if the remaining kidney be affected by a chronic nephritis, pregnancy can lead to exacerbation of the disease.

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## MALIGNANT TUMORS OF THE TESTICLE

A PATHOLOGICAL STUDY

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*Introduction.*—Several earlier publications by the authors on tumors of the testicle have been devoted chiefly to their clinical aspect, with particular reference to treatment. The present paper is concerned with their pathology and with the purpose of presenting further evidence to attempt to solve the widely disputed problems as to their histogenesis. The conclusions reached are based on a detailed study of 22 cases of testicular tumors.

*Historical Note.*—Reference to the literature cannot help but impress one with the confusion and disparity of opinion extant respecting the pathology of testicular tumors. No satisfactory classification based on firmly established histogenetic facts has hitherto been presented and received general acceptance. The variety of tumors reported in the voluminous literature on testicular neoplasms runs the entire gamut of our oncological glossary, so that attempts in the past to bring some semblance of order out of this chaotic condition have been beset with difficulties and any further effort to throw light on this phase of the subject is of importance.

A brief historical resumé of the subject is essential as an approach to a clear understanding of the present status of their pathology. As early as 1696, St. Donat described a complex tumor of the testicle in which he recognized the bones of a rudimentary skull and two pigmented depressions which he interpreted as the embryonic eyes of a parasitic foetus (Ewing). In 1845, Sir Astley Cooper wrote an elaborate treatise on the gross characteristics of testicular tumors. Johnson, in 1856, is credited as being the first to recognize the tridermal constitution of certain tumors of the testicle. In 1887, Langhans and Kocher ventured the opinion that the group of teratomata embraced a large proportion of all tumors of the testicle, and laid the basis for an accurate classification according to microscopic structure. It remained for Wilms, however, in 1896 to demonstrate conclusively the fact that most tumors of the testicle are teratoid in nature. In 1911, Ewing published the most important and authoritative contribution to the pathology of testicular tumors. From a painstaking review of the literature and the analysis of a series of 19 cases, he came to the conclusion that practically all tumors of the testicle are teratomatous in origin, or fundamentally tridermal in constitution,

## MALIGNANT TUMORS OF THE TESTICLE

although in a certain percentage of cases one type of tissue (a monodermal derivative) may have overgrown the other constituents and given rise to the appearance of a unicellular or homologous type of tumor.

He thus challenged the contention of Chevassu, whose exhaustive treatise had been published in 1906, and that of Debarbardi appearing the same year. Chevassu had demonstrated that a large proportion (about one-half) of tumors of the testicle were of a solid medullary, large celled type, the cells being identical in morphology and staining reactions with certain cells of the spermatogenic cycle, namely, the spermatocytes. (Fig. 7.) These tumors, presumably derived from cells of the seminal tubules, he called "seminomes." Schultz and Eisendrath (1921), describing the same type of tumor applied the term "spermatocytoma." Earlier investigators including Tizzoni (1876), Birch-Hirschfeld (1877), Talavera (1879), and Langhans (1887), studied this type of tumor and believed they could trace the gradual transition of the seminal epithelium into neoplastic formations. Chevassu, although a champion of the spermatogenic origin of this type of growth, did not accept this earlier work since he himself was unable to actually demonstrate this transition.

Although the classification of testicular tumors has become greatly simplified through the classical investigations of Wilms, Ewing and others, there have arisen two opposing schools, one maintaining that, "for practical purposes there exists only one tumor of the testicle, namely, a teratoma" (Ewing, O'Crowley and Martland, Wilms, Pick, Ribbert, etc.); the other, that in addition to the obviously teratomatous group of tumors there exists a large proportion of testicular neoplasms which are purely homologous or single-cell tumors (seminomes) derived from the cells of the spermatic tubules (Chevassu, Frank, Schultz and Eisendrath, Sakaguchi, Vecchi, Geist and Thalheimer, Hardouin and Patel, etc.).

It is now possible, we believe, to effect a reconciliation of these opposing views with the evidence at hand.

*Analysis of Personal Cases and Discussion.*—The detailed reports of the 22 cases in our series are appended. Analysis of this series shows that 10 are diagnosed teratomata or mixed tumors (heterologous tumors) and 12 as "seminomes" or single-celled tumors (homologous tumors). The two types occur with about equal frequency, coinciding with the statistics of Chevassu, who in a series of 120 testicular neoplasms found that 59 were seminomes and 61 were teratomata and with the report on the pathological material of 22 cases of the Johns Hopkins Hospital personally examined by one of us (Hinman, 1914), of which 12 were single-celled and 10 mixed tumors. There were no sarcomata. In only one mixed tumor of our present series was there any tissue that suggested sarcoma, but even in this case the malignancy of the growth was due to epithelial proliferation. This point is emphasized because the literature abounds with reports of "sarcoma testis." Indeed, this seems even at present to constitute the most frequent diagnosis

in cases reported, in spite of the authoritative contributions of Wilms, Ewing, Chevassu, Schultz and Eisendrath, and others who have firmly established the fact that sarcoma of the testicle, occurring either as a pure homologous tumor or as a part of a heterologous tumor, is exceedingly rare. Undoubtedly, the term "sarcoma" is applied in the literature in most instances to the seminoma type of tumor because of the histological resemblance to lymphosarcoma or large round-cell sarcoma.

All of our 22 cases of testicular tumor were definitely malignant, supporting the contention, now well established, that practically all tumors of the testicle are malignant. The adult teratoid tumor or dermoid, such as was described by St. Donat, is of great rarity, notwithstanding the fact that many so-called benign mixed tumors are reported. Respecting other types of benign tumors, Ewing accepts only two cases reported by Chevassu and Pick as authentic. These were adenomata of the seminal tubules, and are quite different from the seminoma which is considered as arising from the seminal tubules. Benign interstitial cell tumors have also been reported, but are evidently examples of hyperplasia rather than neoplasia (Ewing).

Other tumors which may at times be confused with testicular tumors are those arising in the epididymis, spermatic cord or testicular tunics. These are of rare occurrence as compared with testicular tumors, and differ from them in being nearly always homologous, and quite as often benign as malignant. The malignant forms are usually sarcomatous. We have had but three extra-testicular tumors primary in these structures—a fibroma of the spermatic cord, an adenocarcinoma of the epididymis, and a fibroma durum of the tunica vaginalis. A complete review of the subject of tumors of the epididymis, spermatic cord and testicular tunics was published (Hinman and Gibson) in 1924.

Thus, the final analysis shows that we have to consider but two types of testicular tumor, both of which are malignant, the teratoma or mixed tumor and the seminoma or unicellular type of tumor. The pathology of testicular tumors would be further simplified if we could accept Ewing's dictum that the seminoma is also of teratomatous origin, and represents merely a one-sided (monodermal) development of a tumor primarily tridermal in constitution. Ewing maintains that this hypothesis is subject to proof and states that in several instances he has been able to demonstrate other types of tissue in the seminomata as well as seminomatous tissue in teratomata. His beliefs, however, have been largely ignored or discredited, as shown by the fact that several observers have since reported series of the seminoma type in which careful study failed to reveal mixed tissues (Schultz and Eisendrath) and conversely search of characteristic mixed tumors failed to reveal any areas of the seminoma type of cells. Although we have not subjected our own specimens to serial section, we have been impressed with the uniformity of seminomata as distinguished from mixed tumors and were likewise skeptical of Ewing's beliefs until studying specimen No. 2356 in our series. We have always subjected our seminomata to careful histologic study in an effort to

## MALIGNANT TUMORS OF THE TESTICLE

corroborate Ewing's theory, and were finally able to do so with this single specimen in which mixed tissues of various types were found abundantly associated with typical seminomatous tissue. (Figs. 4 and 5.) *The term "seminome" or "spermatocytoma" must therefore be regarded as a misnomer, and the contention of Chevassu is disproved in favor of Ewing's theory.*

To what adult tissue the cells forming this peculiar tumor are related is impossible to say any more than it is possible to relate certain other types of tissue occurring in teratomata, but Ewing regards it as an epithelial type and calls them "embryonal carcinomata" of teratomatous origin. Obviously, the overgrowth of this type of tissue so as to completely shut out the other teratomatous components must either occur very early in the life of the tumor, or else be due to an unusual degree of malignancy with rapid cellular proliferation. We favor the former explanation, since clinical experience has taught us that this type of tumor is apparently no more malignant than other types.

In general, the malignant elements in mixed tumors of the testicle are almost uniformly epithelial in type, and therefore carcinomatous in nature. It would therefore seem logical to regard the so-called "seminome" as a carcinomatous proliferation in a tumor primarily teratomatous in origin. The peculiar lymphoid stroma, which forms a more or less constant feature of this type of growth, is not explained on an inflammatory basis, but further than that, no explanation of its significance has been offered.

The carcinomatous elements in teratomata are generally amenable to classification into one or more of three groups, (a) trophoblastic (chorioepithelioma), (b) hypoblastic (the usual adenomatous tumor), and (c) epiblastic (solid alveoli of basal-cell type or tumors of neurocytoma type). All three of these types are denoted as "embryonal carcinoma" by Schultz and Eisendrath. Ewing limits the term "embryonal carcinoma" to the seminome type of tumor. The first type is comparatively rare. Doctor Cooke, formerly of the Department of Pathology of the University of California Medical School, was able to collect but 47 cases. It is of interest to note that only about one-half of the choriomata reported revealed other types of tissue. The second type (hypoblastic), exclusive of the so-called "seminome," comprises the vast majority of teratomata, and is figured in the accompanying histologic illustrations of mixed tumors.

Summing up briefly, it can now be taken as definitely established that practically all tumors of the testicle are teratomatous in origin, and furthermore that practically all testicular tumors exhibit some type of carcinomatous degeneration of which the so-called "seminome" is but a modification. Furthermore, pathologically and to some extent clinically, the "seminome" presents certain vital differences which set them apart from the other teratomata. Clinically, it is now fairly well established that the "seminome" is relatively susceptible to radiotherapy, whereas other types of teratoma are less favorably influenced. There is a different age incidence, the majority of teratomata occurring in the third decade and seminomata in the fourth decade.

Pathologically, the differences are well illustrated in the gross and microscopic characteristics shown in accompanying figures. The "seminome" presents grossly (unless altered by hemorrhage and necrosis) a uniform solid picture (Fig. 2) and microscopically a solid medullary type of growth (Figs. 3, 6 and 7) in which other types of tissue are rarely found. Other teratomata present grossly a characteristically complex cystic picture (Fig. 1), and histologically an equally complex picture (Figs. 9, 10, 11), in which one sees various types of carcinomatous proliferation, cystic spaces lined by different types of epithelium, islands of squamous cells, islands of cartilage, etc., all supported upon a more or less abundant connective-tissue stroma.

On the basis of these facts, it should be possible now to establish a scientific and accurate classification of testicular tumors which could receive general acceptance. The difficulty lies in creating a suitable terminology for the type of tumor hitherto miscalled "seminome" or "spermatocytoma." Shall we retain the term "embryonal carcinoma" applied to it by Ewing or the descriptive term "seminome"; or shall we add to the existing confusion by introducing a new terminology? The term embryonal carcinoma is neither appropriate nor distinctive, since practically all teratomata exhibit epithelial degeneration which could rightly be termed "embryonal carcinoma." No distinctive new term suggests itself, with the remaining alternative to continue calling this distinctive group of tumors "seminomata," bearing in mind that these tumors are teratomatous in origin and that this term is merely descriptive, denoting a resemblance to, and not an origin from, the seminal cells or spermatocytes. Until a better term is substituted, it will serve a useful clinical purpose in differentiating between the two great groups of testicular tumors of a common origin. In our present state of knowledge, it is impossible to say whether the seminome is trophoblastic, hypoblastic, or epiblastic in nature, since, as Ewing has said, "It is a highly characteristic structure which is duplicated by no other structure." It seemingly duplicates, or at least resembles, the epithelial cells of the spermatic tubules, the spermatocytes, so that perhaps it falls into a separate category, namely, mesoblastic, since the gonads are of mesoblastic derivation.

To be more explicit, let us follow the development of such a tumor through from the beginning. Teratomata are characterized by their potentiality to reproduce all the structures in the human body. They are tridermal in constitution, all the primitive germ layers being present. It is logical to assume, therefore, that a teratoma may reproduce the cellular characteristics of the adult testicle, just as it may form bone, cartilage, glandular tissue, etc. In other words, a teratoma is capable of reproducing seminal epithelium which may undergo neoplastic transformation just as other epithelial structures in a teratoma may do, and then proliferate to such an extent as to completely overgrow other types of tissue originally present. Obviously, from our present knowledge of the pathology of teratoma testis, the seminome cannot be classed with either trophoblastic, hypoblastic, or epiblastic types of teratoma, so that the only remaining alternative may be mesoblastic. Hence it

## MALIGNANT TUMORS OF THE TESTICLE

is possible that the "seminome" represents an epithelial overgrowth of mesoblastic origin in a teratoma. Since the gonad with its seminal epithelium is of mesoblastic origin, the seminome may well be a carcinoma of seminal epithelium on a teratomatous basis, but this theory is of course purely conjectural.

The following classification of testicular tumors, a modification of Schultz and Eisendrath, is submitted:

### I. Homologous Tumors:

#### A. Benign:

##### 1. Epithelial:

- (a) Adenoma of the seminal tubules (the tumors of Chevassu and of Pick are accepted by Ewing).

##### 2. Mesoblastic:

- (a) Interstitial cell tumors (probably not true tumors, but merely hyperplasia (Ewing)).

#### B. Malignant: (Do not occur).

### II. Heterologous Tumors (Teratomata or Mixed Tumors):

#### A. Benign:

- 1. Adult teratoid tumors or cystic dermoids. (Exceedingly rare.)

#### B. Malignant: (Embraces practically all tumors of the testicle.)

- 1. *Embryonal Carcinoma*: (Heterologous tissues may be present or may have been overgrown.)

(a) Trophoblastic (chorioepithelioma). (Rare.)

(b) Hypoblastic (the usual adenomatous tumor).

(c) Epiblastic (solid alveoli of basal-cell type or tumors of neurocytoma type).

(d) Mesoblastic (?) (so-called "seminome"). (They constitute about one-half of the malignant tumors occurring in the testicle.)

- 2. *Sarcomatous Mixed Tumor*: (True sarcoma occurring in a teratoma is very rare. Probably the few authentic cases of sarcoma reported as homologous tumors represent one-sided developments of teratomata.)

*The Site of Origin of Teratoma Testis.*—The ultimate solution of the pathogenesis of testicular tumors is identified with that of teratomata in general. The many theories of origin of teratomata are still unproved and it would be useless to review them here, since we have nothing new to add. We are satisfied for the moment with having demonstrated that practically all tumors of the testicle, including the seminome, are teratomatous in origin. The precise point at which tumors of the testicle first begin is still debatable. Most tumors examined have been so far advanced that most or all of the testicle was replaced. In some, however, a narrow margin of testicular tissue remains at a point opposite the attachment of the epididymis. It would seem, therefore, that the tumor arose in the region of the rete testis or in the region immediately between the testis and epididymis, possibly from some vestigial mesonephric structure. An unusual instance of early tumor is shown in Fig. 3, in which the tumor occupies the site of the epididymis which is compressed into a thin capsule. Only a few small foci of tumor cells are found in the testis.

These facts lend support to Ewing's theory, in which he believes that

teratoma testis arises from totipotent sex cells in the rete, and from there invade the testis proper. In the unusual instance just cited it is conceivable that the tumor, following the path of least resistance, chose to grow toward the epididymis rather than into the fibrous, atrophic testicle.

## CASE REPORTS

*I. Teratomata*

CASE I.—C. A. L., age twenty-four years. History of injury to the left testicle one and one-half years ago followed by tenderness and swelling. Tenderness disappeared, but testicle remained large. Wassermann at this time was positive; received anti-luetic treatment, but testicle continued to enlarge. Loss of ten pounds in last one and one-half years. A radical operation for teratoma testis was performed; the vas and all pre-aortic lymph-glands were resected. Much bleeding was encountered during the course of operation. The mass of glands adherent about the inferior mesenteric artery necessitated resecting the artery.

The patient died



FIG. 1.—Photograph of mixed cell type of testicular tumor, a teratoma, in sagittal section. No normal testicular tissue is seen and there are multiple dissimilar areas and cystic spaces characteristic of different types of tissues, such as cartilage, gland, etc. Note the contrast between this type of tumor and the uniform picture of the single cell type of tumor illustrated in Fig. 2. The size of the tumor was 9 x 10 cm.

suddenly while joking with a friend the following day of what clinically looked like embolism. Autopsy not permitted.

*Gross Pathology.*—The tunica and epididymis are involved in a dense mass of adhesions. Upon section, the tunica everywhere appears infiltrated with tumor. The interior is filled by an irregular fungating growth resembling a mixed tumor.

*Microscopic Pathology.*—Examination shows a variety of pictures. In some places there is cartilage, normal in character. The background in some areas is composed of a fairly cellular fibrous tissue, showing edema. coursing through it are numerous epithelial structures, at times lined by a single layer of epithelium of low cuboidal form. In other regions, duct-like structures are lined by high columnar epithelium, one layer thick; in still other regions are more duct-like structures and papillomatous masses consisting of epithelium many layers in thickness. It is especially among these cells that mitoses are observed. In the stroma associated with such areas there is some lymphocytic infiltration and larger irregular necrotic areas. In the necrotic areas, one not infrequently sees evidence of old hemorrhage. The invasive character of the growing epithelium in many

## MALIGNANT TUMORS OF THE TESTICLE

areas is quite striking and definite invasion of endothelial-lined cavities is seen. There are also noted epithelial structures lined by stratified epithelium, the central cells of which are undergoing keratinization.

Several glands removed at radical operation show cancerous invasion, which for the most part forms structures with a somewhat papillomatous appearance, the superficial cells of which form a somewhat irregular layer, while the small cells have an oedematous reticulated appearance. Necrosis of considerable extent occurs together with spaces corresponding to cholesterol crystals, about some of which is slight giant-cell formation. There is also pigmentation of old hemorrhage. In other areas the invading epithelium is of the more deeply stained type, although there are suggestions of transitions between the types.

*Diagnosis.*—Teratoma testis with glandular metastases.

CASE II.—S. C., No. 564.

*Microscopic Pathology.*—Examination shows large connective-tissue stroma which in itself exhibits a variety of pictures, from myxomatous degeneration to dense cellular sarcomatous appearing areas.

Numerous cysts are seen showing many variations, some being lined by columnar epithelium, while others have cuboidal epithelium. Many contain an eosinophilic material which appears as colloid. Other spaces are filled with small darkly staining cells in alveolar formation. Still others are lined by typical cornifying squamous epithelium in which the keratohyalin granules may be seen. In some small areas are definite adenocarcinomatous cell groups infiltrating the connective-tissue matrix. Occasional cystic spaces may be seen to be filled with inflammatory exudate containing polymorphonuclear cells. Groups of lymphocytes appear in various areas of the stroma, giving the appearance of minute abscess formation.

*Diagnosis.*—Teratoma testis.

CASE III.—S. P., No. 1137. *Microscopic Pathology.*—Examination of sections shows a dense connective-tissue matrix which is replaced to more than one-half in extent by areas of epithelial proliferation. The epithelial growth closely resembles a papillary cystadenoma, malignant in character. The papillary type of growth loses its identity in some areas forming a more medullary type of growth. In the centre of some of these large areas is a moderate amount of inflammatory reaction, as indicated by the presence of polymorphonuclear neutrophiles; also in some of those areas may be found extensive areas of necrosis. The carcinomatous areas are well circumscribed, there being no diffuse infiltration through the connective-tissue matrix.

The individual epithelial cells vary in morphology, but are uniformly small and bear

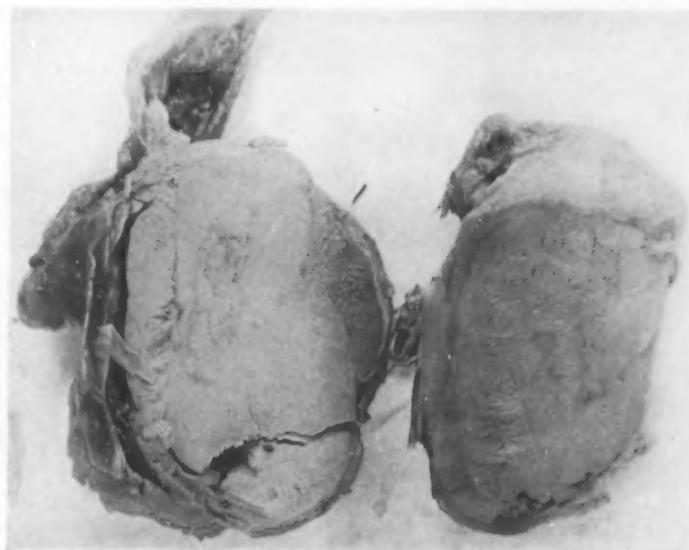


FIG. 2.—Photograph of a single cell type of testicular tumor, a seminome. At the inner edge of the left half of the specimen is seen a small compressed remnant of testicular tissue. This type of tumor is characterized by its uniformity and homogeneity in the gross and microscopic picture, although occasionally there may be areas of necrosis. The tumor measured 5 x 7.5 cm.

no resemblance to the spermatoblast type of cell. Their nuclei are round or oval and seem devoid of cytoplasm. The chromatin is irregularly distributed. The cell nuclei contain one or more nucleoli and frequent mitoses are seen. No other type of epithelial growth can be seen in the sections examined. The connective-tissue matrix is fairly uniform in structure and does not appear sarcomatous in any area. On one margin of a section examined is seen atrophic testicular tissue and on the side opposite, tubules of the epididymis.

*Diagnosis.*—Teratoma testis with adenocarcinomatous tissue.

**CASE IV.**—R. D., No. 1450. *Microscopic Pathology.*—Examination shows a variety of tissues. There is a connective-tissue matrix which shows ramifications throughout of

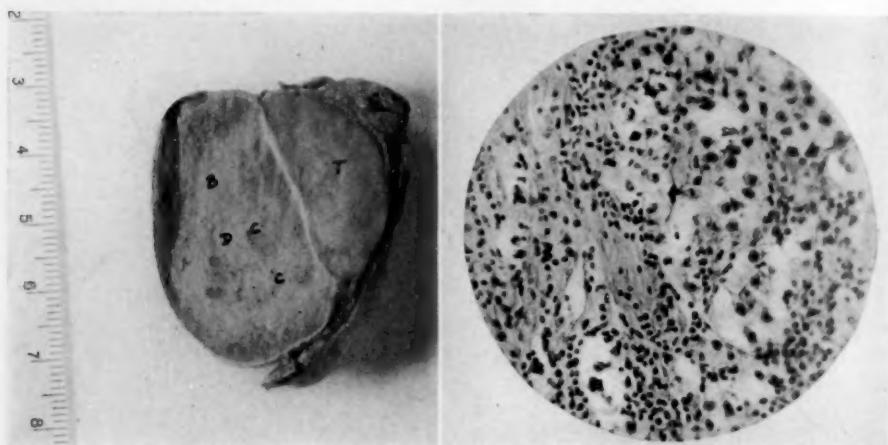


FIG. 3.—A. Photograph of sagittal section of an undescended testicle removed at operation from a patient of twenty-seven years. T, Malignant tumor (seminome); E, epididymis; B, atrophic testicle; A, margin of normal glandular tissue; D, area of necrosis and hyalinization. The solidity of the tumor mass and its circumscribed margin are evident. There is a definite line of demarcation between tumor and testicle, and the compressed shell of epididymis can be peeled off the tumor everywhere except at the upper pole, to which it is intimately attached. A few small foci of tumor cells are present in the testis at the points marked C. The position of this tumor may indicate the possible site of origin of testicular tumors in the rete or some embryonic vestige between the testis proper and the epididymis. This tumor has apparently followed the line of least resistance, growing toward the epididymis rather than the fibrotic testicle. B. Photomicrograph (high power) showing typical area from tumor T. Note the solid unicellular type of tissue with a lymphoid stroma, characteristic of the "seminome." The cells are somewhat exceptional, showing more cytoplasm than usual.

epithelial cells growing in wild disorder, but tending on the whole to assume a rough pattern of adenocarcinoma. This pattern is lost in places, the cells tending to grow in solid sheets. The epithelial cells appear large, with abundant eosinophilic cytoplasm and having indistinct borders. The nuclei varying markedly in morphology and staining properties, differ in this respect from the large round nuclei of the seminome cells with their uniform fine stippling. Areas of necrosis are present. The growth infiltrates diffusely in areas, giving the tissue an almost scirrhus appearance. In other areas are cystic spaces lined by various types of epithelium varying from the flat to narrow columnar type.

*Diagnosis.*—Teratoma testis.

**CASE V.**—B. W., No. 1567. Age thirty-seven. Two months ago patient noticed that his right testis was beginning to swell. This had always been slightly larger than the left. Increase in size came on suddenly and without any evident cause. Orchidectomy with removal of inguinal glands was performed. The patient was seen in the clinic on several occasions during the following few weeks. He continued to lose weight and the abdominal masses gradually enlarged. Death occurred two months after castration. Autopsy showed enormous metastatic tumor masses in the pre-aortic retroperitoneal space and nodules in the liver and lungs with the same histologic picture as the testicular tumor.

## MALIGNANT TUMORS OF THE TESTICLE

*Pathological Report.*—Malignant mixed tumor of the testicle with retroperitoneal metastases.\*

*Gross Pathology.*—Specimen consists of large ovoid mass measuring 6.5 x 11 cm. The vas is thickened and nodular. The epididymis is replaced by a large nodular mass. Upon section the tumor grits under the knife, suggesting cartilage. An extremely variegated surface is presented. Numerous cystic areas are seen, partially filled with grumous, mucoid or hemorrhagic appearing material. The intervening areas present a cellular appearance with small islands of cartilage in relief. Other areas show much fibrous tissue and numerous areas of necrosis more or less hemorrhagic in character.

*Microscopic Pathology.*—There are numerous areas which show epithelial-like cells with comparatively little stroma. These are often arranged around blood-vessels in the form of islands, separated by necrotic material. Many mitoses are seen. There are other areas which show groups of cells which are rather large with small, round nuclei and stippled cytoplasm. These appear very much like fetal fat cells. There is an abundance of fibrous tissue throughout.

*Diagnosis.*—Mixed tumor of testicle, malignant.

CASE VI.—E. L., No. 2021. Age thirty-three years. Patient had noticed that his right testicle was larger and harder for the last two and one-half years. Neisserian infection twice—left epididymitis with first attack and balanitis; followed by bilateral buboes. Three Wassermanns were negative and two salvarsans caused no change in size of tumor.

A radical operation for teratoma testis with resection of the pre-aortic glands was performed. There was uneventful convalescence until the twelfth day, when the patient complained of severe pain down the left leg (operation on right side). There was marked tenderness over the femoral vessels and distention of the superficial veins with considerable edema. Complete recovery with discharge at the end of three weeks. The patient died nine months post-operative.\*

*Gross Pathology.*—Specimen consists of a mass closely resembling normal testis except that it is slightly larger than normal, measuring 2.5 cm. x 4 cm. The vas and epididymis appear normal. The tunica is smooth and presents no nodules or adhesions. The mass is very firm in contrast to the normal testis. Upon section through the long axis, the knife cuts with difficulty and grits on substance which is presumably cartilage. The cut-surface presents a variegated picture characteristic of the malignant mixed tumor of the testis. There are numerous cystic cavities of varying size, some filled with grumous material, others with mucoid substance. The solid portions of the growth vary from grayish-white to yellow in color, interrupted here and there by areas of hemorrhagic necrosis. The tunica albuginea is thin and the tumor appears everywhere confined within its limits. No normal appearing testicular tissue is evident anywhere in the specimen.

*Microscopic Pathology.*—Sections of the testicle show a mixed picture. There are two distinct conditions shown, namely new growth and massive degeneration. The new growth shows in some areas tumor cells rather loosely grouped together with moderate intercellular connective tissue. In other areas there is an attempt at gland structure, in others there is a tendency to a papillomatous arrangement. The blood supply is poor and small areas of degeneration are seen everywhere. The vessels have very thin walls and in some areas where degeneration is rather marked, the peripheral arrangement is present. The predominating cell is large, irregular in shape, but with a tendency toward being oval, with nucleus occupying large part of cell and varying according to the shape of the cell. Atypical mitoses are abundant. There is one area where from two to six cells are grouped together and surrounded by a thin sheath of connective tissue suggesting nerve structure.

*Diagnosis.*—Teratoma testis.

\*Hinman, Frank: Radical Operation for Teratoma Testis; with Report of Five Cases. *Surg., Gyn. and Obs.*, 1919, vol. xxxviii; p. 495.

CASE VII.—R. B. W., No. 2189. Age thirty years. History of trauma to left testicle seven years ago. Noticed soon after a small lump on the left testicle which gradually grew until within a year it was a mass twice the size of a normal testicle. Unchanged until nine months ago, since which time it has been increasing in size and becoming more painful.

A radical operation was performed for teratoma testis with complete resection of lymphatic areas along the iliac artery and abdominal aorta. There was an uneventful recovery. Pathological examination showed an early metastasis to one retroperitoneal lymph-gland. Patient living and well, five years post-operative.†

*Gross Pathology.*—Specimen consists of ovoid mass, roughly egg-shaped, measuring 6 x 8 cm. The tunica albuginea is everywhere smooth and intact. The epididymis and vas appear normal in size and consistency. The digital fossa is well preserved and there is no evidence of adhesions. The mass is very firm on pressure. Upon section through the long axis is seen a fairly uniform, smooth, grayish-white structure darkened here and there by hemorrhagic extravasations. The cut surface appears very cellular and does not present cystic spaces and irregularities. There is no evidence of normal testicle, the growth filling the entire tunica albuginea.

*Microscopic Pathology.*—Sections through the tumor show a great variety of pictures—predominating is a diffuse arrangement of carcinoma-like cells and adenomatous arrangement of epithelial cells. The cells lining the spaces are for the most part of the columnar variety; a good many resemble perithelial arrangement. There are many alveoli resembling well-developed thyroid. There is an abundance of myxomatous tissue in places showing a tendency toward a papillomatous arrangement. Areas are seen in which small, round, nucleated heavy stained cells are densely packed together, suggesting lymphoid tissue. No cartilage is seen; no squamous epithelium in full stage of development. The picture is of a mixed tumor type with a preponderance of epithelial elements.

*Diagnosis.*—Teratoma testis.

CASE VIII.—W. C., No. 2356. Age thirty-six years. Mumps several years ago with right orchitis resulting in atrophy. Two Neisser infections and chancre. Had two and one-half years' treatment for lues. Four months ago while at work patient slipped and strained himself. The right testicle became swollen and tender. Under intense anti-luetic treatment, the tumor increased in size. A radical operation was performed for teratoma testis with resection of pre-aortic glands. Pathological examination showed extensive metastases to the lymph-glands. Patient discharged one month post-operative; lost track of since two months after operation.†

*Gross Pathology.*—Specimen consists of a mass, shaped like a testicle, measuring 8 cm. in greatest diameter. The cut surface shows interlacing bands of connective tissue, between which are areas of degeneration, areas of quite cellular tissue resembling cartilage in many places, cystic cavities, and various other strange pictures characteristic of malignant mixed tumor.

Fatty retroperitoneal tissue removed at the radical operation containing the regional lymph-nodes of the testicle are also present. One of these glands is much enlarged, being 3 cm. in longest diameter, and it is also quite hard.

*Microscopic Pathology.*—Sections from the testicle show a varied picture. There are spaces lined by columnar epithelium in several layers. Some of these spaces are very large and show a great deal of desquamation into the lumen with regeneration of elements, and many mitotic figures are seen among the active cells. There are other spaces lined by single layers of cuboidal cells, also showing mitoses; the lumen is filled with faintly staining pink substance remotely suggesting colloid. There are areas of cartilage of the hyaline variety. Some sections show enormous islands of cartilage, and also true bone. Large fields of loose connective tissue and, in addition, compact masses

† Hinman, Frank: Radical Operation for Teratoma Testis; with Report of Five Cases. *Surg., Gyn. and Obs.*, 1919, vol. xxxviii, p. 495.

## MALIGNANT TUMORS OF THE TESTICLE

of distinctly connective-tissue cells with deeply staining oval or elongated nuclei showing mitosis, are present.

At least two distinct types of epithelioid proliferation are seen growing diffusely through the stroma in various areas. One, which is very abundant, consists of cells with large oval or round nuclei, showing fine stippling. *These cells are supported on a*

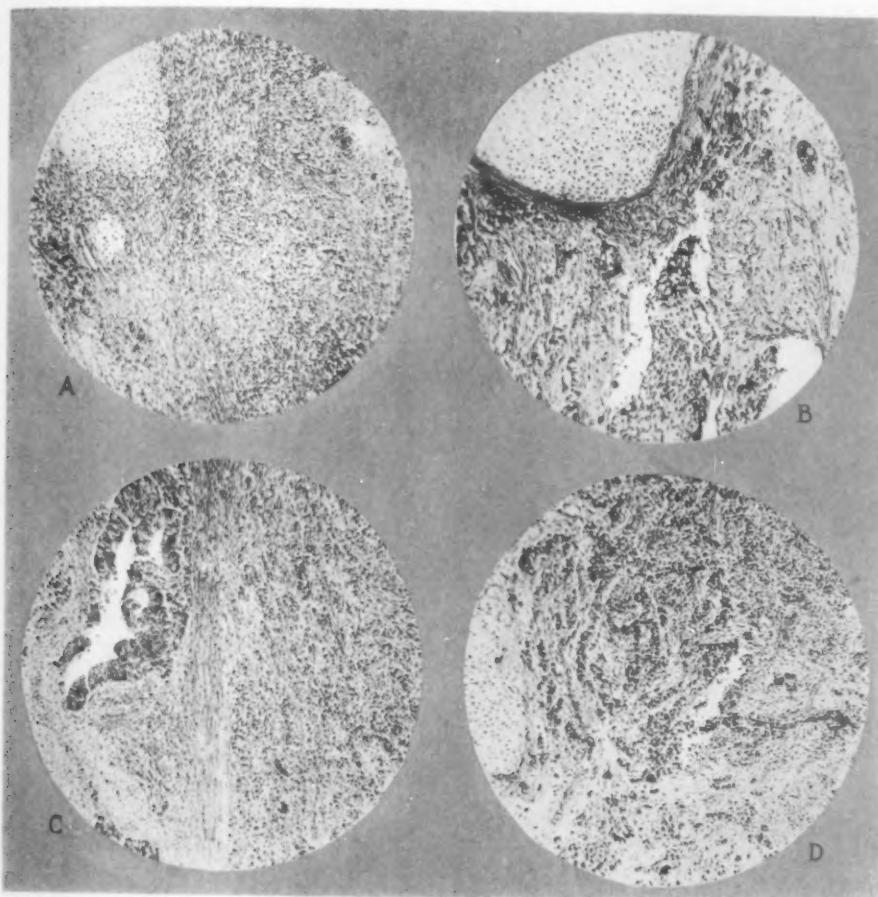


FIG. 4.—Photomicrographs (low power) of characteristic areas from specimen No. 2356. All four photomicrographs show abundant "seminome" tissue occurring with other types of tissue. This is the same type of cell which has been referred to as "embryonal carcinoma" and "spermatocytoma." A. On the left are two distinct islands of cartilage. On the right is a typical field of the "seminome" type of cell, while in the middle lies a dense connective-tissue stroma. B. At the upper margin is a well circumscribed island of cartilage; below this may be seen a loose connective-tissue stroma into which projects a tongue of tissue composed of the "seminome" type of cell. C. On the left is a glandular structure lined with columnar cells such as is often found in the mixed celled (teratoma) type of tumor. To the right and separated by a band of connective tissue are the typical "seminome" cells supported in a fairly abundant connective-tissue stroma. D. Another field showing a great number of "seminome" cells supported in a fairly abundant connective-tissue matrix and associated with a small island of cartilage on the left.

fine lymphoid stroma and are identical in every way with the "seminome" type of cell. (Figs. 4 and 5.)

The other type of epithelioid proliferation which is very prominent consists of large polygonal cells with irregular vesicular nuclei, most of which show a single large nucleolus. The intercellular substance is very scanty. Blood-vessels are numerous. Hemorrhagic and necrotic areas are present, giving the cells in some areas a perithelial arrangement. These cells on the whole have a distinctly alveolar arrangement. Islands of squamous cells are present in various places.

HINMAN, GIBSON AND KUTZMANN

The enlarged gland, noted above, which was removed from between the aorta and vena cava at operation, shows entire replacement of normal elements by metastatic cells of various types in which the epithelial elements, as usual, predominate. The remaining glands show hemorrhage and endothelial proliferation but no definite areas of malignancy. Serial sections from the spermatic cord and globus major show no metastases.

*Conclusion.*—The condition present therefore is one of true teratoma in which the

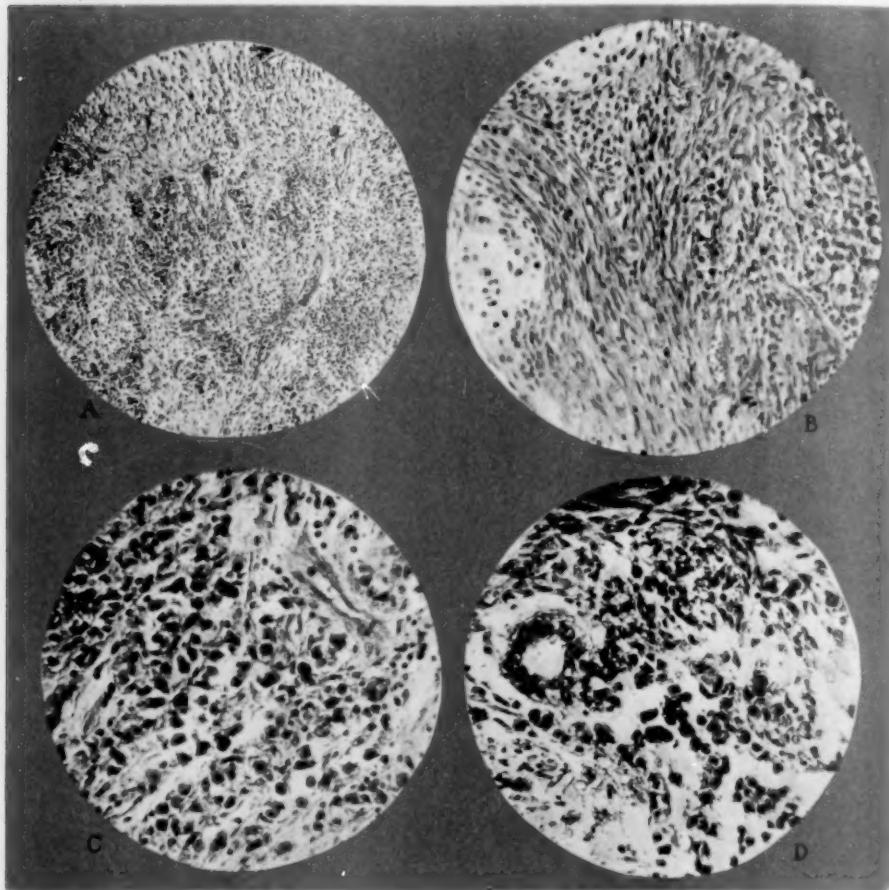


FIG. 5.—Photomicrographs of characteristic areas of specimen No. 2356. A. Photomicrograph (low power) of another area showing numerous groups of the "seminome" type of cell in a connective-tissue matrix. B. Photomicrograph (high power) showing two islands of cartilage at the left bounded by dense connective tissue. At the right margin are "seminome" cells with the characteristic lymphoid stroma. C. Photomicrograph (high power) showing an island of the typical "seminome" cells. Note the large, heavily stained nuclei and the small amount of cytoplasm; at the right margin are some lymphocytes which, as a rule, accompany the "seminome" or unicellular type of tumor. D. Photomicrograph (high power) showing the occurrence of a glandular structure adjoining a group of "seminome" cells.

epithelial elements predominate. Definitely adenocarcinomatous areas, sarcomatous areas, and typical areas of the "seminome" type of tissue are present in abundance intermixed with cartilage, bone, squamous-cell nests, and various types of cystic cavities lined by epithelium. The photomicrographs (Figs. 4 and 5) illustrate clearly the association of "seminome" and other types of tissue present in abundance in the same tumor.

*Diagnosis.*—Teratoma testis with glandular metastasis.

**CASE IX.**—T. K., No. 22-723. Age thirty years. Six months previously, patient noticed some pain in right testicle. Six weeks later noticed small button-like swelling.

## MALIGNANT TUMORS OF THE TESTICLE

This has rapidly grown in size up to the present time. A radical operation for teratoma testis was performed with resection of the pre-aortic lymph-glands. There was an uneventful recovery, the patient leaving the hospital on the twentieth day post-operative. Patient died with large retroperitoneal metastasis eleven months post-operative.

*Gross Pathology.*—The tumor is enclosed within the smooth thickened capsule measuring  $10.5 \times 7.5 \times 6$  cm. Section through the tumor shows a fairly soft, grayish-yellow tissue mass which bulges on cut surface. There is no definite architecture. Irregular edematous bands of connective tissue form a stroma in which lie small nodules of cartilage. Numerous small cystic areas varying in size from 1 to 5 mm. in diameter and several fairly circumscribed, opaque, homogeneous cellular areas. In the central

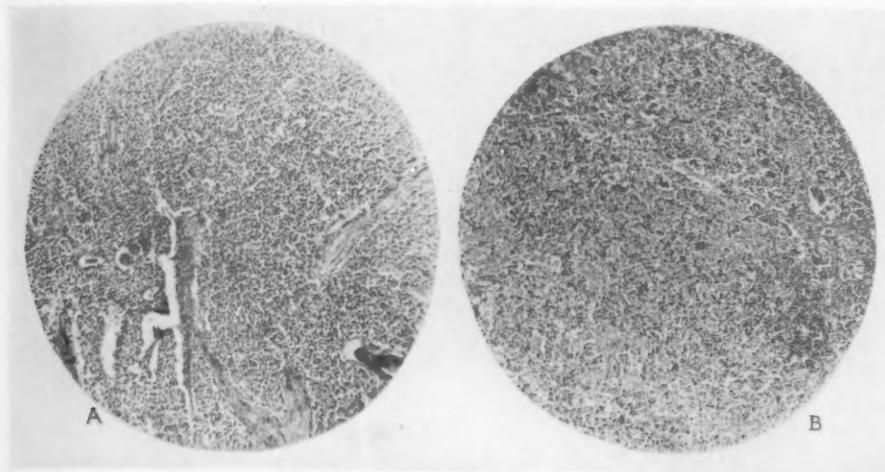


FIG. 6.—Photomicrographs (low power) of areas chosen at random from the typical "seminome" type of tumors exhibiting no other types of tissue. Note the solid medullary type of growth and the resemblance borne to the spermatocytes in Fig. 8. A. Section showing complete absence of the usual characteristic lymphoid stroma. The cells are supported on a scant connective-tissue framework which likewise carries the blood supply. B. Section showing an unusually abundant lymphoid infiltration, the "seminome" cells occurring in small islands. The occurrence of the lymphocytes in this type of tumor are part of the tumor growth and not of any inflammatory reaction.

portion is an irregular, yellowish area of necrosis. On two sides of this area are two hemorrhagic zones.

*Microscopic Pathology.*—The solid portions of the tumor are composed of connective tissue which shows edema and hyalin changes in some areas, while in others it is quite cellular. Irregular bands of smooth muscle are frequently found lying in connective tissue. Masses of embryonal cartilage are scattered diffusely throughout the sections. There are many cystic and glandular structures lined by squamous or columnar epithelium. Small islands of squamous epithelium, neuro-epithelium, and ganglion cells are found. An occasional glandular structure with papillary infoldings may be seen. Several sections show marked proliferation of epithelium in small alveolar gland structures. This type of epithelium is found invading the stroma and forming small nests of cells, which show numerous mitoses—a characteristic picture of malignancy.

*Diagnosis.*—Teratoma testis, malignant.

CASE X.—L. S., No. 25-22. Age twenty-five years. Aching and swelling noted in the right testicle five months ago. The tumor has continued growing gradually. A radical operation was performed for teratoma testis with resection of the pre-iliac and pre-aortic lymph-glands. During convalescence the patient developed a Virchow's node the third week post-operative. Pathological examination showed the same type of tumor as testicular growth with one metastasis to lymph-gland. The patient, however, grew weaker and continued to lose weight, and died suddenly ten weeks post-operative.

*Gross Pathology.*—Specimen consists of large ovoid mass measuring 8 x 10 cm. Upon section a cellular surface with numerous cystic spaces is seen. Stromas and partitions of fibrous tissue are seen coursing through the tumor, giving it a reticulated appearance.

*Microscopic Pathology.*—Examination shows in certain areas testicular tissue, the tubules of which are normal, but the interstitial tissue is irregularly oedematous. Scat-

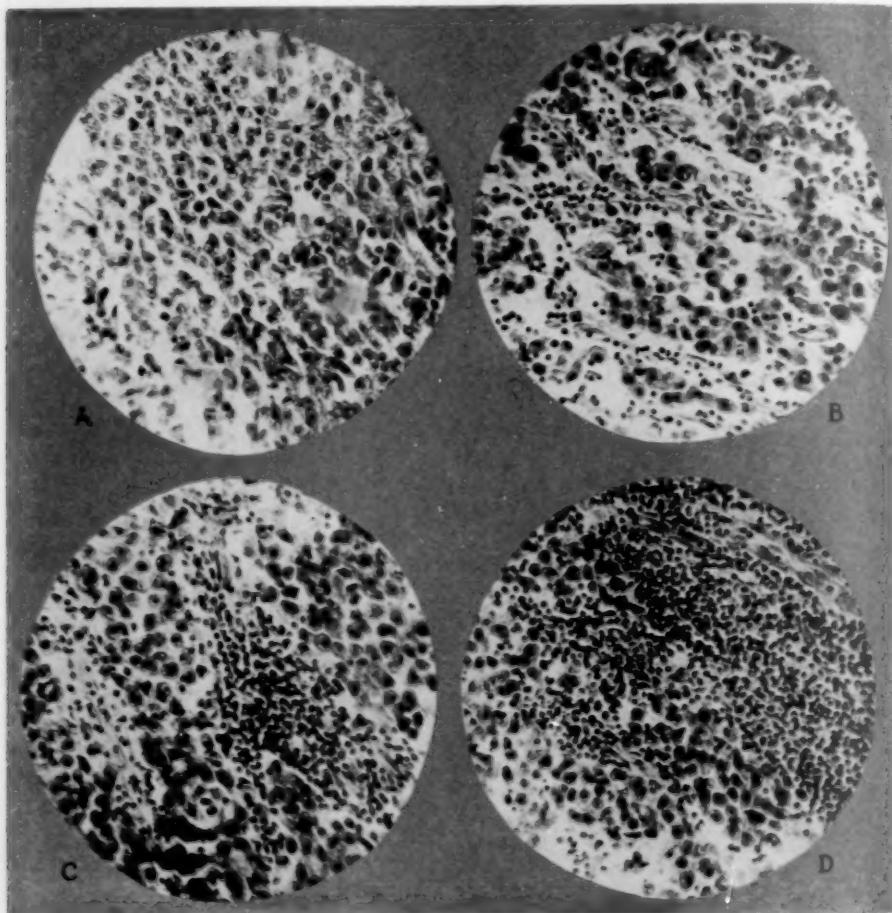


FIG. 7.—Photomicrographs (high power) from "seminome" type of tumors such as is illustrated in Fig. 2. Note that the lymphoid stroma in these groups may vary from a complete absence, as shown in A, to a marked preponderance, as in D. The tumor cell type shown in these photomicrographs was thought by Chevassu to be identical with the spermatocyte, and he, therefore, designated these tumors as "seminomes."

tered in the testicular tissue, and also independent of it, are areas of varying size occupied by a new growth of abnormal epithelial cells growing in a papillary adenomatous pattern. The cells are relatively large with clear-cut nuclei, round to oval in shape, in general presenting relatively a small amount of chromatin material and with a single, often conspicuous nucleolus. The cytoplasm varies in amount and in general appears finely reticulated. Mitoses are frequent. In the fibrous stroma, associated with the new growth, is considerable infiltration of lymphocytes and plasma cells. In some of the areas, carcinoma degeneration, especially of the more central portions of the nodules, is seen.

## MALIGNANT TUMORS OF THE TESTICLE

In other sections, but still more or less intermingled with the carcinoma, are areas of cyst-like structures lined by cuboidal epithelium, others by high columnar epithelium, and still others by squamous epithelium, the latter showing keratohyalin changes and keratinization of the inner layers. Associated with the latter are a few areas presenting degeneration and foreign body giant-cell reaction. An area showing strands of smooth muscle is seen. While no definite cartilage is seen, a few areas of connective tissue have become diffusely hyaline and suggest a pre-cartilaginous reaction.

Section through a gland removed from the spermatic cord during radical operation shows marked infiltration with tumor cells arranged in loose papillomatous pattern upon a hyalinized connective-tissue base. The cell types are similar to those of the primary tumor.

*Diagnosis.*—Teratoma testis with papillary adenocarcinoma and with glandular metastasis.

### II. Seminomata

CASE XI.—E. S. Age thirty. Two months previous, injury to right testis. Testis tender but not swollen. Within a few days it swelled up to twice its normal size, remained stationary for a month, and then continued to increase in size—duration only two months. Orchidectomy was performed by Doctor Eloesser, San Francisco. Pathological examination showed malignant tumor of the testicle. One month later the patient was re-operated and radical operation performed with resection of the lymph-glands along the vena cava and aorta. Uneventful recovery except for one attack of vomiting on the seventh day post-operative, causing a retroperitoneal hemorrhage. The patient is living and well eight years post-operative.‡

*Microscopic Pathology.*—Sections of tumor show tissue, consisting almost entirely of very large polygonal cells with large deeply staining vesicular nuclei. The masses of cells are imperfectly divided by thin connective-tissue partitions in which are large blood-vessels. In sections from the proximal end of cord one finds in the vicinity of some of the nerves small accumulations of large cells, very suspiciously like tumor cells.

*Diagnosis.*—Seminome of the testis.

CASE XII.—Mr. F., No. 920. *Microscopic Pathology.*—Examination shows a typical picture of the seminome pattern. There is the solid type of cellular growth supported on a dense lymphoid stroma, the latter appearing more numerous in some areas than the epithelial cells. The large epithelial cells resemble the spermatoblast type seen in the seminiferous tubules which may also be seen in the margin of the section.

‡ Hinman, Frank: Radical Operation for Teratoma Testis; with Report of Five Cases. *Surg., Gyn. and Obs.*, 1919, vol. xxxviii, p. 495.

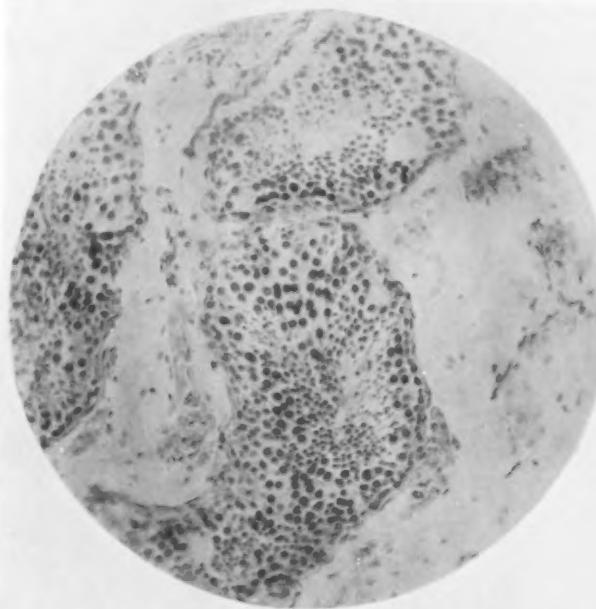


FIG. 8.—Photomicrograph (high power) of a section through a normal adult testicle, illustrating the spermatogenic cycle. Compare the spermatocytes in this figure with those illustrated in the preceding photomicrographs of "seminomes."

The growth extends between the remaining tubules and not within their lumen. No other type of tissue can be found in the slides examined.

*Diagnosis.*—Seminome of testis.

CASE XIII.—V. S. P., No. 2370. Age twenty-nine. History of growth of right testicle to size of lemon in five months, accompanied by pain and interfering with walking. Radical operation for teratoma testis was performed with resection of the glands from the pre-aortic region. There was an uneventful recovery. The patient died twenty months post-operative.<sup>8</sup>

*Gross Pathology.*—Specimen consists of an oval mass measuring 10 cm. in its greatest diameter. The cut surface presents a fairly uniform grayish-white cellular picture with numerous areas of necrosis and degeneration with formation of small cavities. Strands of connective tissue divide the tumor mass into irregular indistinctly separated lobules.

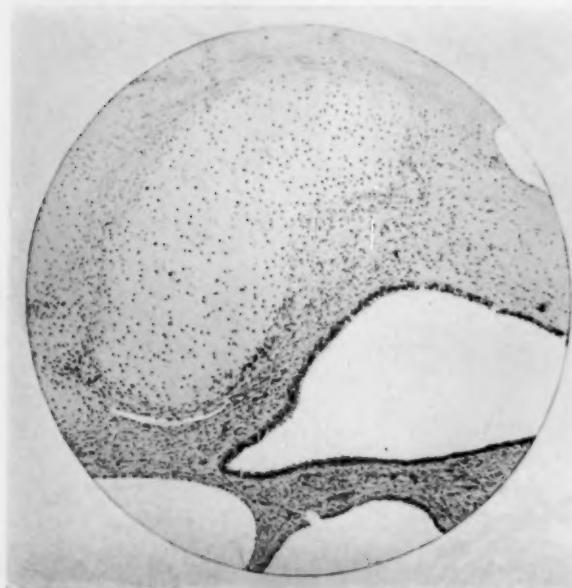


FIG. 9.—Photomicrograph (low power) of a teratoma showing area of cartilage and three cystic spaces, each lined with a different type of epithelium-cuboidal, short columnar and high columnar.

and are also seen passing through the midst of the mass of a single endothelial layer. There is quite a tendency to disintegration, in some areas due probably to poor blood supply. These areas show considerable blood pigment and lymphocytic infiltration. Mitotic figures are abundant.

A lymph-gland removed during radical operation from between the aorta and vena cava shows itself to be entirely replaced by cells of the same type as in the testicular tumor.

The type of tumor cell closely resembles the spermatoblasts, from which Chevassu derives this type of tumor.

*Diagnosis.*—Seminome of the testis with glandular metastasis.

CASE XIV.—Mr. L., 20-2404. *Gross Pathology.*—Specimen consists of testicle, is roughly egg-shaped, and measures 8 cm. in its greatest diameter. The cut surface is quite mottled and shows large areas of degeneration, and is quite hard in some areas, due to tough cartilaginous-like connective tissue. In between these areas is a grayish-white granular material.

*Microscopic Pathology.*—The type of cell found is large, round, or polygonal, with a faintly staining or non-staining clear cytoplasm, a relatively large nucleus, vesicular in

<sup>8</sup> Hinman, Frank: Radical Operation for Teratoma Testis; with Report of Five Cases. *Surg., Gyn. and Obs.*, 1919, vol. xxxviii, p. 495.

## MALIGNANT TUMORS OF THE TESTICLE

character, with one or more nucleoli. Mitotic figures are abundant. The cells are laid down in large fields quite closely packed together in a minimum of connective tissue. Throughout these fields are broad irregular bands of connective tissue. Here and there are groups of cells or debris which stain almost black. There are quite a few fairly large areas of degeneration and these are mostly in the form of caseation. Careful search fails to reveal definite evidence of the presence or preëxistence of any specialized tissue outside

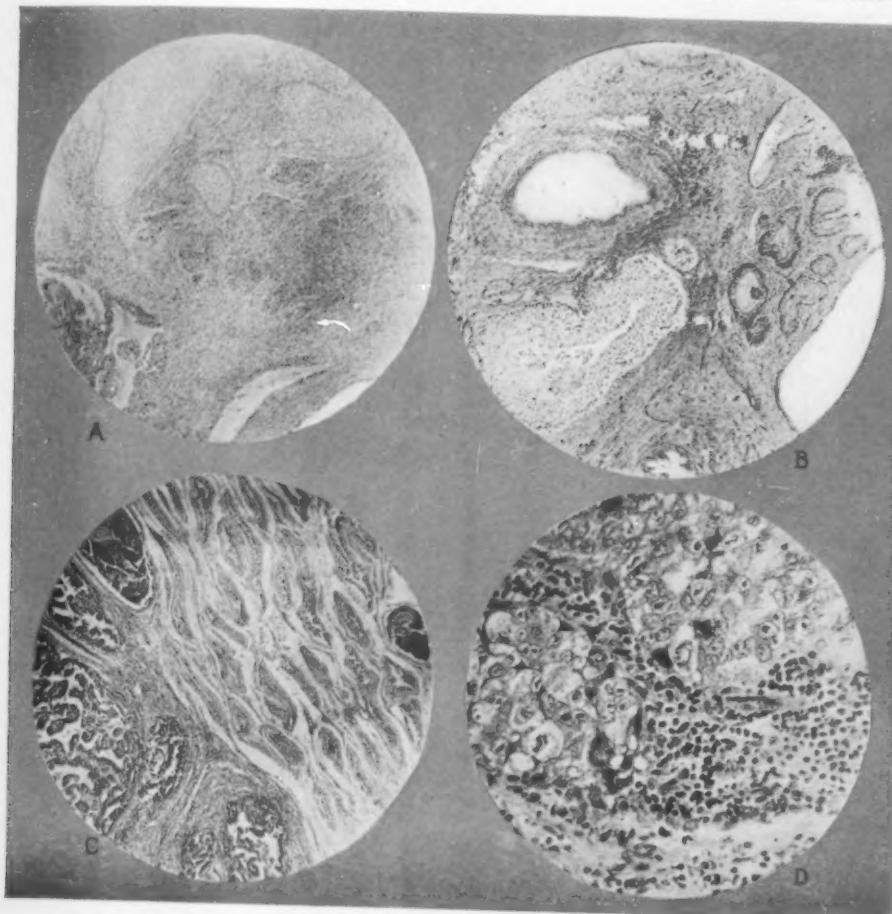


FIG. 10.—Photomicrographs of representative areas in mixed tumors (teratoma) of the testicle. A. Low-power view of area showing a connective-tissue stroma showing islands of cartilage, nerve-ganglion cells. B. Low-power view showing the various types of glandular structures in a connective-tissue matrix. C. Low-power view showing a carcinomatous area in a teratoma encroaching on the normal testicular tissue. D. High-power view showing large vesicular carcinoma cells in a teratoma. Note the presence of a lymphoid stroma in this case. This demonstrates that such a lymphoid stroma can occur in either the "seminome" or mixed cell type of tumor.

of the supporting connective-tissue framework. Differential staining proves the supporting tissue to be fibrous.

*Diagnosis.*—Seminome of the testicle.

CASE XV.—A. M., 20-2643. Age thirty-four years. History of trauma to left testicle five years ago. Seven months ago noticed left testicle increasing in size and that it had become stony hard in consistency. A radical operation was performed with resection of the glands along the spermatic vessels and iliac artery up to the aorta. There was a chain of enlarged glands running up the aorta, all of which could not be

resected. Uneventful recovery. The pathological examination of the glands removed showed metastasis with the same type as the testicular growth. The patient received several X-ray treatments over the abdomen during a period of one and one-half years. Patient living and well one and one-half years post-operative.

*Gross Pathology.*—Specimen consists of an ovoid mass, 5 x 7 cm. The epididymis is entirely obliterated by tumor. Upon section is seen a very uniform, smooth, whitish, cellular surface with occasional fine bands of connective tissue running through the growth. No necrosis is seen. The growth almost completely fills the tunica albuginea except in one area where a small band of normal testicle is seen.

*Microscopic Pathology.*—Examination reveals a dense medullary type of growth with irregular strands of reticular connective tissue supporting numerous lymphoid cells. The

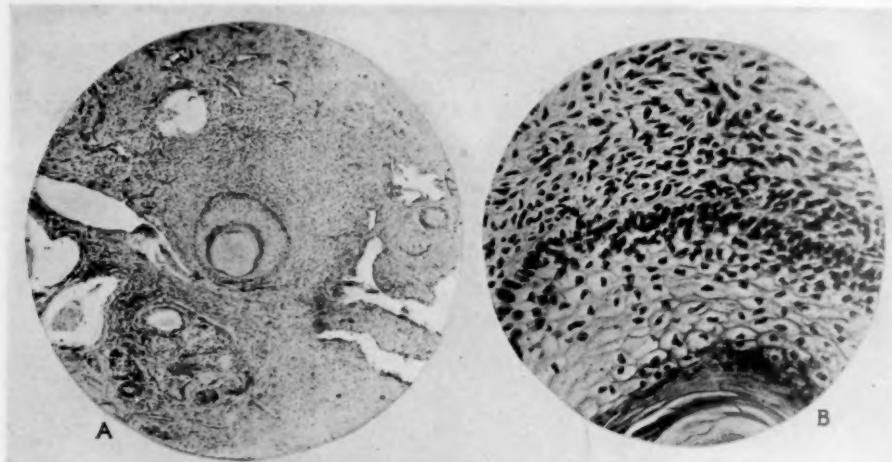


FIG. 11.—A. Low-power view showing an area in a mixed tumor of the testicle showing an island of squamous cell formation along with other glandular elements. B. High-power view of margin of island of squamous cells as shown in centre of preceding illustration. Note the characteristic cornification and keratohyalin granulation.

tumor cells are large and uniform, closely resembling spermatoblasts. The protoplasm is abundant, finely granular and faintly stained. The nuclei are large, round or oval, possessing one to two nucleoli. The chromatin presents a characteristic stippled or granular arrangement. Numerous mitoses are seen, many of them atypical. An occasional multinuclear giant cell, resembling those of tuberculosis, is seen. The growth follows no definite pattern and seems characteristic of the seminome of Chevassu.

A metastatic gland removed from the bifurcation of the aorta during radical operation presents extensive malignant infiltration with cells characterizing the primary growth.

*Diagnosis.*—Seminome of the testis with glandular metastases.

**CASE XVI.**—J. L., 21-2369. Age fifty-two years. Inguinal lymph-glands palpable since the age of ten years. At the age of twenty there was an egg-sized lump in right groin; it remained this size for almost thirty years. For the last several years it has grown in size. Six months ago additional lumps formed in both loins until at present they are of enormous size.

*Gross Pathology.*—Specimen consists of two huge pieces of material, one being as large as a child's head. The tumors are quite bosselated and show a marked degree of degeneration, especially at the centres. The under surface, or the line of division in separating the tumors from the body, shows soft necrotic tissue, indicating that tumor tissue had been left behind.

*Microscopic Pathology.*—Sections show great masses of tumor cells closely packed together with a scanty reticulum and separated off into large fields by very heavy

## MALIGNANT TUMORS OF THE TESTICLE

connective-tissue trabeculae. There is a great deal of degeneration with loss of substance or in the form of coagulative necrosis. Blood-vessels are not especially frequent, though it is not uncommon to find large spaces engorged with blood and without blood-vessels surrounded by the tumor cells. The individual cells are polygonal. The cytoplasm is quite clear, the cell outline is quite sharp and the nucleus relatively large. The nuclei seem vesicular, the chromatin is rather coarse. Nucleoli are not definitely seen in the majority of cells. Mitoses not very abundant. Here and there may be seen tumor cells varying from one to five times in size to the ordinary cell. Occasionally these are multinucleated. The picture seems like a lymphosarcoma and in many respects resembles endothelioma. With the clinical findings pointing to a testicular origin, the case can well be classed with the seminome of the testicle.

*Diagnosis.*—Seminome of testicle with huge inguinal metastases.

**CASE XVII.**—No. 22-1337. *Gross Pathology.*—Specimen consists of two pieces of tissue which when put together make half of an egg-shaped mass, measuring 8 x 5 cm. The cut surface is very soft and spongy, and varies in color from a slightly yellowish-white at the capsule to an iron-gray in the centre. Lobulations can be made out. At one pole is an area of degeneration with some liquefaction.

*Microscopic Pathology.*—Sections show complete loss of architecture and replacement with tumor tissue. The cells are polygonal or round, have rather sharp cytoplasmic outline with relatively scanty amount of cytoplasm, rather deep staining vesicular nuclei with very pronounced nucleoli. Mitoses are frequent. Blood-vessels are numerous. The connective tissue supporting the framework is rather abundant, but in the form of rather delicate reticulum. In most of the section there is a small lymphocyte background or infiltration, the cells being limited to the connective-tissue partitions and framework. Careful search fails to reveal anything that resembles thyroid tissue or epithelial tissue such as glandular structures or fibromuscular organs.

*Diagnosis.*—Seminome of the testicle.

**CASE XVIII.**—I. S., No. 22-1377. Age twenty-seven years. Born with an undescended testicle, situated anterior to the external ring, at times tender, but seldom painful. Occasional pain and swelling of the testicle, subsiding in a few days, last attack being three months ago.

*Gross Pathology.*—Specimen consists of a flattened, roughly spherical mass. Upon section there is seen two distinct parts or lobules, one about half the size of the other. The testis appeared fibrotic except for a narrow margin of normal brownish gland tissue opposite the epididymis. The body of the epididymis was replaced by a solid opaque circumscribed tumor mass, which appeared to be separated from the testicle by a definite capsule. The globus major and minor were preserved.

*Microscopic Pathology.*—Sections show large, circular tumor cells in small clumps, about an equal amount of lymphoid cells and an abundant, rather dense and hyalinized connective tissue. The large tumor cells have a very sharp cytoplasmic outline. The cytoplasm is clear or very finely granular. The nuclei are rather large with the chromatin coarsely distributed. Mitoses are frequent. The lymphoid cells are not inflammatory in origin but have the appearance of the true lymphoid cell of the lymph-gland. The supporting connective tissue contains many cells which suggest an endothelial nature and in many instances there are peculiar circular clumps of cells in some cases suggesting giant cells and in others an abortive attempt to produce a blood-vessel.

*Diagnosis.*—Seminome of the testicle.

**CASE XIX.**—C. D., No. 23-274. Age forty years. Painless swelling of the right testicle of one year's duration. Pain above the iliac crest of four months' duration; gastric distress of two months' duration.

*Gross Pathology.*—Specimen consists of testicular mass measuring 8 x 4 cm. Upon cross-section about one ounce of clear straw-colored fluid escaped from the tunica vaginalis. The cut surface shows a solid granular tumor mass, being grayish-white in color, somewhat friable.

*Microscopic Pathology.*—Examination shows homogeneous fields of large circular tumor cells, having a sharp protoplasmic outline. The cytoplasm is clear or finely granular. The nuclei are rather large, the chromatin coarse. Mitoses are frequent. Here and there may be seen occasional interstitial strands of connective tissue, which in some areas contains large vesicular cells; it also contains small blood-vessels. The picture is typical of the seminome of Chevassu. The lymphoid stroma so often seen in these tumors is lacking in this case.



FIG. 12.—Photograph of patient showing ulcerated inguinal metastases from a "seminome" type of growth. Metastases to inguinal glands are unusual and occur usually when the testicular tumor has involved the skin of the scrotum which it rarely does. The testicular lymphatics drain directly to the preaortic lymph glands and, therefore, are the ones most usually involved.

seminome. So much necrosis and superimposed infection are present as to rather mask the picture. The lymphoid stroma, which varies greatly in different cases, is not very noticeable here. There is some effort at scar tissue formation about the edges of the necrotic areas. The tumor cells resemble closely the spermatocytes. The cells are large and vesicular, each with a large, round or oval nucleus, darkly stained or finely stippled, containing one to two nucleoli.

*Diagnosis.*—Seminome of the testicle.

**CASE XXI.**—No. 25-264. *Gross Pathology.*—Resembles closely the shape of normal testicle, being seven and one-half in its greatest diameter. The tumor is well encapsulated, there being no infiltration of the tunics. The tumor externally is smooth; its consistency is quite firm. On section is seen a solid granular surface, characteristic of the seminome. No normal testicle is seen.

*Microscopic Pathology.*—Examination shows a solid medullary type of growth con-

tinued from the previous paragraph

*Diagnosis.*—Malignant tumor of the testicle—seminome, with hydrocele of the tunica vaginalis and cord.

**CASE XX.**—A. N., No. 23-829. Age forty-five years. Injury to the right testicle three and one-half years ago. The testicle gradually increased in size and became stony hard in consistency. Orchidectomy five months ago. Pain and mass in epigastrium.

*Gross Pathology.*—Specimen consists of the major portion of a testicle. The cut surface shows numerous large, sharply demarcated, angulated areas varying in size from a pin point to 2 cm., which are yellowish-gray, soft, friable and are more or less degenerated.

*Microscopic Pathology.*—Examination shows solid, large cell, medullary type of growth characteristic of the

## MALIGNANT TUMORS OF THE TESTICLE

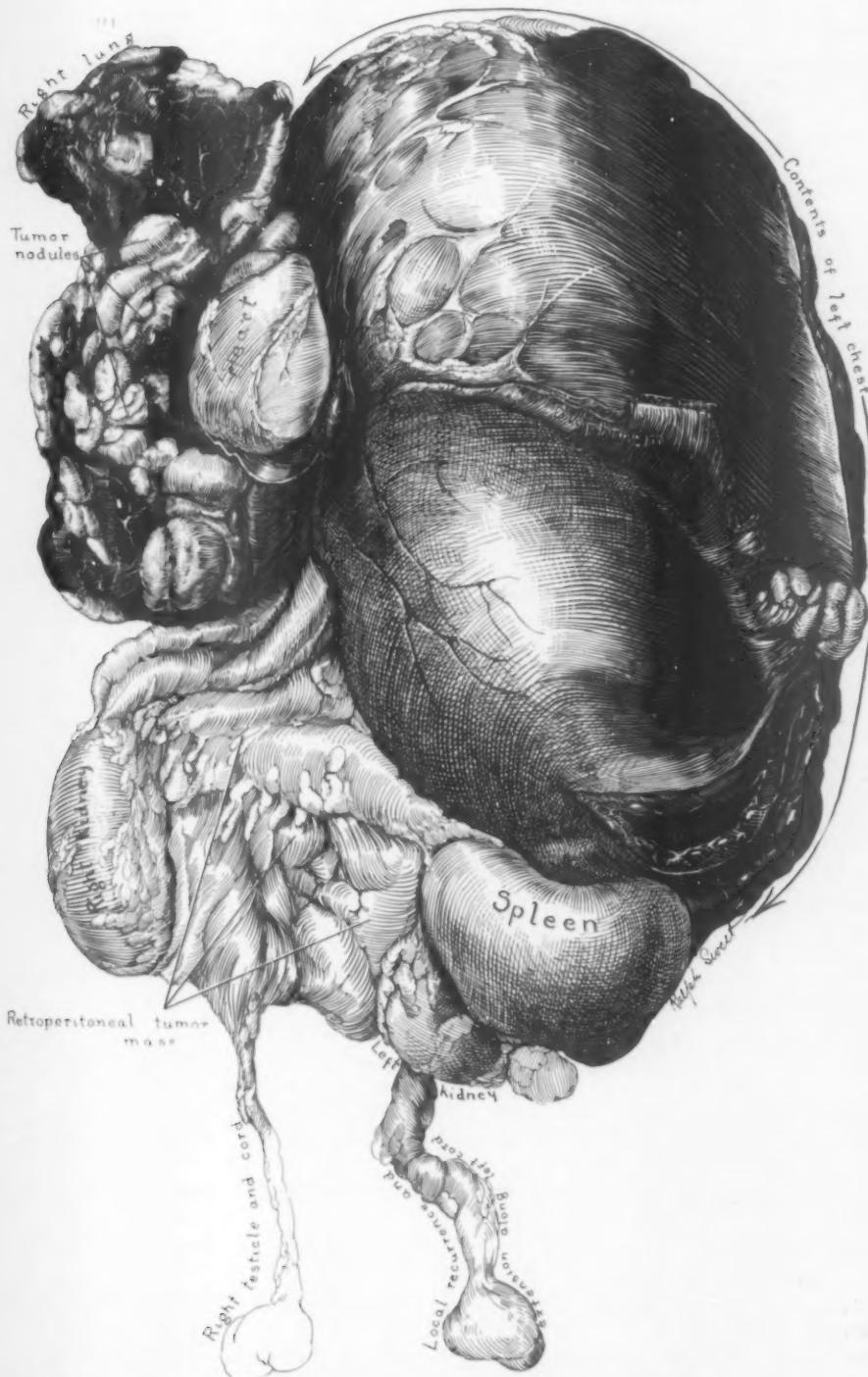


FIG. 13.—Drawing from autopsy (Case 22) illustrating the usual mode of metastases in malignant tumors of the testicle. Metastases in this case occurred to the retroperitoneal lymph glands, the liver and the lungs. The left chest was completely filled by one huge metastatic tumor mass with displacement

sisting of cells containing large round nuclei and an indistinct cytoplasmic border. The nuclei contain one to two nucleoli and the chromatin material shows an uniform stippling similar to that of the spermatoblast. A slight amount of lymphoid stroma can be seen in some areas. A few areas of necrosis are present. There are frequent mitoses. At one margin of the section normal appearing epididymis is made out. No other types of tissues are seen.

*Diagnosis.*—Seminome of the testicle.

**CASE XXII.**—*Note:* The following case is included in this series because of the typical pathology found at autopsy in the metastases.

E. C. Age ten years. History of injury to the left testicle six months ago, followed by tumor formation with left orchidectomy five months ago. The patient entered the University Hospital because of pain in the left chest, cough, malaise and weakness. Examination showed recurrent nodule in the left scrotum.

Autopsy showed diffuse metastases to the retroperitoneal glands, liver and filling almost the entire chest.

*Microscopic Pathology.*—Sections from the nodule in the left scrotum show a richly cellular tissue composed of numerous undifferentiated polyhedral cells supported by a connective-tissue stroma. The cells vary in their arrangement, occurring in some places diffusely or in sheets, in other places, and quite frequently as more or less continuous linings of numerous small irregular spaces. The latter by an anastomosing network of connective-tissue strands give the growth an alveolar-like structure. The cells lining these spaces, as well as those diffusely present, are in general poorly defined, possessed of very little cytoplasm and for the most part made up almost entirely of large vesicular nuclei. The latter contain a varying amount of chromatin, usually finely granular and fairly evenly distributed. Some of the nuclei are hyperchromatic. Some possess nucleoli. Mitoses are frequent. The stroma consists of finer and coarser strands of a pale fibrillar tissue. Stroma and parenchyma are present in about equal amounts, though varying somewhat in proportion. Scattered here and there throughout the stroma are a few small, rather darkly staining cells consisting of lymphocytes, neutrophiles and degenerating tumor cells. The picture is one suggestive of the seminome.

Sections from the various scattered metastases present a similar picture.

*Diagnosis.*—Seminome (recurrent) of the left testicle with metastases to retroperitoneal glands, liver and lungs (thorax). (Fig. 13.)

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## RETROPERITONEAL HERNIA\*

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FROM THE CLEVELAND CLINIC

ALTHOUGH retroperitoneal herniation of the intestines may occur through the foramen of Winslow or into the fossæ in the duodenal, cæcal or sigmoid regions, the types which occur in the region of the duodenal-jejunal flexure comprise the majority of the reported cases.

The infrequent occurrence of these herniae is indicated by Nagel's publication in 1923.<sup>12</sup> He reported one hundred cases of left and twenty-eight

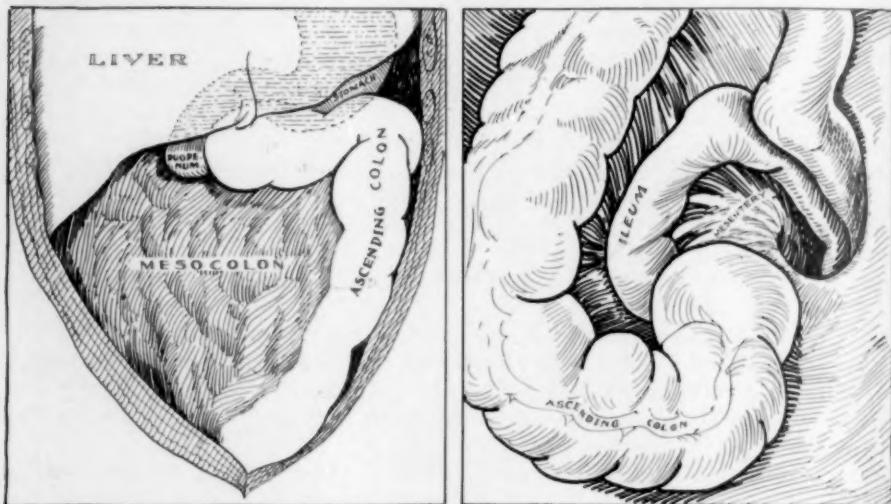


FIG. 1.—Right paroduodenal hernia. a. Appearance on opening abdomen. b. Ascending colon reflected showing hernia into right paroduodenal fossa.

cases of right paroduodenal hernia. In view of these facts, it has appeared to us that it might be of value to add two more, one of each type, to the reported cases, and to offer a brief discussion of the etiology, diagnosis and treatment of this condition.

### REPORT OF CASES

**CASE I.**—A girl, thirteen years of age, entered the hospital on September 25, 1922, complaining of abdominal distention and vomiting. The family and personal histories gave no information pertinent to the existing condition, and until nine weeks before the girl's health had been excellent. At that time she began to vomit and distention of the abdomen became evident, most of which disappeared after enemas. The nausea occurred usually at night. There was no fever and no severe pain. The bowels were costive. The child complained of a general feeling of distress throughout the entire abdomen.

\* Read before the American Surgical Association, May 5, 1925.

## RETROPERITONEAL HERNIA

Physical examination revealed an emaciated girl with the abdomen markedly distended; a palpable mass which felt like intestines matted together was present in the right lower quadrant. No tenderness was elicited. On auscultation over the mass a gurgling sound was audible while percussion yielded a resonant note. The blood and urine were normal.

The pre-operative diagnosis was partial intestinal obstruction from appendicitis, tuberculosis or a dermoid cyst.

Operation.—The abdomen was opened through a right rectus incision. Exploration



FIG. 2.—Plate before operation showing deformity of cecum.

revealed the abdominal cavity free from small intestines and a portion of the ascending colon, all of which occupied the retroperitoneal space. (Fig. 1.) After elevating the ascending colon and mesentery, the point of herniation was located. The superior mesenteric artery was present on the anterior margin of the fold while the neck of the sac was just below and to the right of the fourth lumbar vertebra and in close approximation thereto. The sac, which was very large, extended from the margin of the lateral abdominal wall past the midline.

The intestines were pulled downward and to the left below the superior mesenteric

## LOWER AND HIGGINS

artery and the hernia was reduced. The neck of the sac was ligated with catgut and reinforced with silk.

Convalescence was satisfactory except for the development of encephalitis lethargica. The patient was discharged on November 2, 1922, and had had no abdominal disturbance when last heard from on January 9, 1925.

CASE II.—This patient was a laborer, fifty years of age. He entered the hospital on November 24, 1924, complaining of pain in the abdomen, abdominal distention and the passing of considerable flatus. The patient had always been perfectly well until two years before when he became aware of progressive constipation. There had been no loss of weight. Neither blood nor pus was present in the stools. He experienced a constant feeling of distress in the right lower quadrant with pain which at times was acute. He had experienced nausea but no emesis. For the preceding two days there had been some elevation of temperature.

Physical examination revealed a well-developed and normal male, weighing 150 pounds. Nothing pertaining to his present condition was elicited excepting the abdominal findings. In the right lower quadrant in the region of the cæcum, there was a large globular circumscribed mass, moderately firm in consistency. The mass was slightly movable, and was neither tender nor rigid. Blood and urine were normal. The X-ray examination revealed in the cæcum a constant filling defect which might be due to a tumor. (Fig. 2.)

On the basis of the above findings the pre-operative diagnosis was tumor of the cæcum.

Operation.—Upon opening the abdominal cavity it was found entirely void of the small intestines which were retroperitoneal. There were many adhesions about the cæcum. Digital examination located the orifice of the sac, the anterior margin of which was occupied by the inferior mesenteric vein. The hernia was very large, extending upward toward the transverse mesocolon and outward toward the descending mesocolon. On account of the firm adhesions the hernia could not be reduced, so the sac was opened in the midline. Dense adhesions of the intestines within the sac prevented reduction, so the wall of the sac was closed and the abdomen closed in the usual manner. (Fig. 3.) Evidently this condition had been initiated two years before and had gradually developed until the complete retroperitoneal hernia found at operation was produced. A diagnosis of appendicitis had been made two years previously, and it is possible that the dense mass of adhesions about the cæcum were due to a primary involvement of the appendix.

The patient made an excellent recovery and was in good condition three months later. (Fig. 4.)

### REVIEW OF LITERATURE

As far as we have been able to discover, the first recognition of retroperitoneal hernia was made in 1861 by Klob,<sup>11</sup> who described a case of right paroduodenal hernia, although in 1857 Treitz<sup>11</sup> described and illustrated retroperitoneal herniae and in 1884 Fürst<sup>11</sup> also discussed their formation. A detailed description with illustrations of the various fossæ was presented by Moynihan in the *Arris and Gale* lectures in 1897; and in collaboration with Dobson, Moynihan again reviewed the literature in 1906.<sup>11</sup> In the more recent literature cases have been reported by Desjardins,<sup>5</sup> Wallace and Allen,<sup>24</sup> Kohlman,<sup>9</sup> Morton,<sup>10</sup> Pidcock,<sup>17</sup> Nixon,<sup>13</sup> Nagel,<sup>12</sup> Novak<sup>14</sup> and others.

### CLASSIFICATION AND ORIGIN

Retroperitoneal herniæ may be divided into four groups, namely, duodenal, pericæcal, intersigmoid and those formed by herniation through the foramen of Winslow.

## RETROPERITONEAL HERNIA

As our cases belong in the first of these groups, we shall confine our discussion to the various types of duodenal herniae. Moynihan<sup>11</sup> describes the following nine distinct types of duodenal fossæ:

1. *The superior duodenal fossa* lies to the left of the ascending portion of the duodenum. This fossa is present in from forty to fifty per cent. of the cases of duodenal hernia. Its size is variable and adhesions or fat deposits may render it unrecognizable.

2. *The inferior duodenal fossa (fossa of Treitz)* is easily located and lies to the left of the ascending portion of the duodenum between the third and fourth lumbar vertebrae. This is present in approximately eighty per cent. of the cases.

3. *The posterior duodenal fossa* lies behind the upper part of the ascending limb of the duodenum. It is present in some degree in the majority of cases.

4. *The duodeno-jejunal fossa* lies at the base of the transverse mesocolon. It may be found in from fifteen to twenty-five per cent. of the cases.

5. *The inter-mesocolic fossa* occupies a position somewhat similar to that of the duodeno-jejunal fossa in that it lies at the root of the transverse mesocolon but unlike the latter, it runs horizontally along the mesocolon.

6. *The paraduodenal fossæ*, of which there are two types, lie to the left of the ascending limb of the duodenum. The inferior mesenteric vein or the superior mesenteric artery may serve as guides in locating these fossæ.

7. *The intra-duodenal fossa* may occur in the region of the duodeno-jejunal angle. It is not constantly present.

8. *The mesenterioparietal fossa* lies behind the superior mesenteric artery and may be found by examining the first part of the mesojejunum.

9. *The parajejunal fossa* also lies behind the superior mesenteric artery and is easily located in the first part of the mesojejunum; it is closely associated with the mesenterioparietal fossa. Moynihan reports the occurrence of two definite cases in adults.

Many theories regarding the formation of these folds and fossæ into which herniation may occur have been proposed, chief among which are the following:

1. Traction folds. (Nixon.)<sup>13</sup>
2. Tense margins of the fossa combined with freedom of movement of the intestines plus peristalsis. (Treitz.)<sup>14</sup>
3. Embryonic origin as late descent of the cæcum.
4. Failure of the root of the mesentery to unite with the posterior abdominal wall.
5. Formation of pockets during intestinal rotation.
6. Formation of fusion folds in fetal life.
7. Elevation of the peritoneum by blood-vessels. (Waldeyer.)<sup>15</sup>
8. Physiological adhesions. (Toldt.)<sup>16</sup>
9. Mesoduodenum (remains of early folds). (Treves.)<sup>17</sup>

Several of these causes for the formation of the fossa, combined with other factors, may give a logical explanation for the formation of retroperitoneal hernia.

The embryonic formation of "fusion folds" is not accepted as the origin of the fossa into which herniation occurs. These folds were described by Langer and Toldt<sup>11</sup> and later by Moynihan,<sup>11</sup> the former stating that portions of the common dorsal mesentery adhere to and fuse with the posterior abdominal wall during the progress of intestinal rotation.

From observations made in the dissection of fetuses, Nagel described the process of intestinal rotation and fixation in different successive stages. He demonstrated the adherence of the mesentery to the underlying parietal peritoneum and showed that later all evidences of the opposing surfaces tended

to become unrecognizable. Thus the parietal peritoneum covering the abdominal cavity is formed by the free portion of the mesentery.

The question now arises as to why these fossæ occur so frequently in the duodenojejunal region. In the early stages of embryological progression the superior mesenteric artery acts as an axis of rotation, the mesentery of the large and small intestines spreading out fan-wise across the abdomen (Prentiss and Arey).<sup>18</sup> If this centre of rotation is in the duodenojejunal area, the relative frequency of occurrence of this type of retroperitoneal hernia may thus be partially explained.

Late descent of the cæcum may play a part in the formation of folds in the pericæcal types, but there is not sufficient evidence to this effect.

As for Waldeyer's theory we hardly believe that this offers a logical

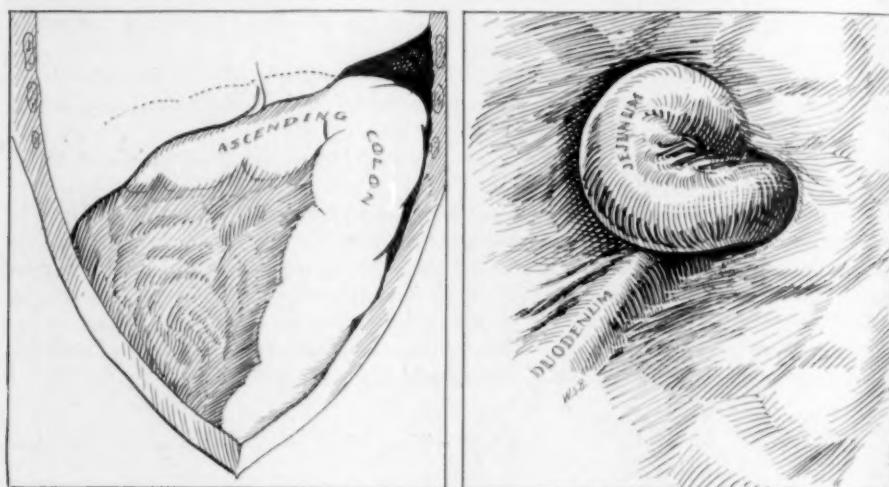


FIG. 3.—Left paraduodenal hernia. a. Appearance on opening abdomen. b. Greater part of small intestine withdrawn from hernia.

explanation for the development of the fossa. That the superior mesenteric artery is present in the anterior margin of a right paraduodenal hernia is true, but the presence of the artery can not account for the formation of the fossa. Similarly in left paraduodenal hernia the inferior mesenteric vein is usually present. That these vessels may form a point of resistance and thus promote the further enlargement of the fossa as the intestines are forced within it, would seem plausible; but we do not believe that the vessels are primary factors in the formation of the folds.

We agree with the views of Moynihan,<sup>11</sup> and Langer and Toldt<sup>11</sup> cited above, that the fossa into which the herniation occurs is formed by fusion folds.

*Incidence.*—Retroperitoneal herniæ are uncommon. Very few cases, especially of right paraduodenal hernia, have been reported in the literature, the majority of reported cases being of the left paraduodenal type. Moynihan and Dobson<sup>11</sup> reported sixty-five cases of left and seventeen cases of right paraduodenal hernia. Short collected fourteen additional cases. Primrose,<sup>19</sup>

## RETROPERITONEAL HERNIA

Nuzum,<sup>15</sup> Novak<sup>14</sup> and Pidcock<sup>17</sup> have also reported cases. In 1923, Nagel<sup>12</sup> collected twenty-nine cases of right paraduodenal hernia to which two more cases should be added, one that reported by Novak and Sussman<sup>14</sup> and the other our own case, thus making a total of thirty-one authentic and four unauthentic (Cooper, Pikin, Zander and Willes)<sup>12</sup> cases; and to Nagel's collection of 100 cases of left paraduodenal hernia we also add another case.

*Symptomatology and Diagnosis.*—The symptoms of paraduodenal hernia



FIG. 4.—Plate after operation showing similar deformity, but filling of jejunum with barium.

are vague and a correct interpretation of the physical findings is difficult. This well explains the fact that a correct diagnosis was not made in any among the total thirty-one cases of right paraduodenal hernia; and that among ninety-one cases of left paraduodenal hernia cited by Pikin<sup>12</sup> only three correct diagnoses were made.

The symptoms are those of chronic or acute intestinal obstruction. In the chronic cases, however, the patient complains of feelings of distress which are quite unlike the ordinary symptoms of an intestinal disorder. Distention,

## LOWER AND HIGGINS

nausea, vomiting, belching and constipation are common, but the general condition of the patient may remain unimpaired for a long period of time. Acute cases are marked by the usual symptomatology presented in cases of acute intestinal obstruction due to other causes (volvulus or intussusception).

Upon physical examination a mass is frequently palpable. This is globular and cystic in character, and usually situated in the right lower quadrant. Upon auscultation a gurgling sound is audible over the tumor while percussion yields a sonorous, tympanitic note. Dilation of the veins on the anterior abdominal wall, or enlarged hemorrhoidal vessels, may be present, these being due to pressure on the inferior mesenteric vein. There may be visible peristalsis. X-ray examination is of little aid in the diagnosis as the hazy outlines and deformities are difficult to interpret. The condition is usually identified only at operation or necropsy.

*Treatment.*—Surgical intervention is the only line of treatment indicated in these cases. In reducing the hernia, care must be exercised to avoid injuring vessels in the anterior margin of the fossa. This applies especially to right paraduodenal hernia in which the superior mesenteric artery is present in the anterior superior margin of the fossa; and also to left paraduodenal hernia in which the inferior mesenteric vein is in such close proximity to the anterior margin. The presence of these vessels may make it impossible to enlarge the neck of the sac by incision in which case careful stretching with the fingers may enlarge it sufficiently to facilitate the return of the intestines to their normal position. Sometimes the presence of numerous dense adhesions may prevent the reduction of the hernia. In such a case the neck of the sac should be enlarged as much as possible to prevent strangulation of the intestines and the resultant development of acute obstruction. These complications must be governed by the condition of the patient and the judgment of the surgeon. After the contents of the sac have been reduced the sac should be closed by ligature preferably distal to the blood-vessels, thereby avoiding injury to the latter.

Short<sup>22</sup> and Philips<sup>16</sup> report a series of twenty-eight cases of left paraduodenal hernia. Among seventeen cases which were operated upon, an incomplete operation was performed in one, and of the remaining sixteen cases, thirteen were cured and three died. Among twelve cases of right paraduodenal hernia two cases were cured and ten died. These figures show that the surgical treatment of these herniae, of right paraduodenal hernia in particular, is hazardous, and great care must be exercised in reducing them.

## SUMMARY

An investigation of the literature shows that the incidence of retroperitoneal hernia is relatively rare, and that the majority of the reported cases are of the paraduodenal type. The literature includes reports of thirty cases of right and 100 of left paraduodenal hernia, to each of which we add one more. The diagnosis is rarely made before operation. Surgical intervention is neces-

## RETROPERITONEAL HERNIA

sary but the operation is hazardous. The vessels in close proximity to the margin of the fossa must be avoided. If the hernia can be reduced and a satisfactory ligation of the sac can be made, complete recovery should follow.

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OBSERVATIONS ON THE HISTOLOGIC AND PATHOLOGIC  
ANATOMY OF THE HEPATIC, CYSTIC, AND  
COMMON BILE DUCTS\*

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THE gall-bladder is looked on as the most important part of the extrahepatic biliary passages. An enormous amount of experimental and clinical data have accumulated concerning it. Its susceptibility to disease has made it prominent from a surgical standpoint. The effects of its removal, especially those of a mechanical nature, have received attention probably because its apparent and most easily understood function is mechanical. Much less attention has been paid to the extrahepatic bile ducts, and one can search in vain the standard text-books of anatomy for a detailed description of them, although their gross appearance and anatomic relations are well known. The constantly increasing frequency of operations for removal of diseased gall-bladders and the many more instances of untreated disease of the biliary tract serve to emphasize the importance of the ducts. In fact, the gall-bladder is almost insignificant when compared with the essential nature of the hepatic and common ducts.

According to Heisler, the liver begins as a single evagination from the gut tube which quickly bifurcates into the anlagen of the right and left lobes. It grows between the layers of the ventral mesentery into the septum transversum and the liver ridge. The latter forms the connective-tissue part of the liver, but the hepatic cells and the epithelial cells of the ducts come from the original evagination of the gut. The hollow stalk by which connection is maintained with the gut forms the common duct. That the original diverticulum is single is the opinion of His, Kölliker, Hertwig, Minot, and Piersol. The gall-bladder takes origin as an outpouching of this diverticulum. It should be noted that the extrahepatic bile ducts have a common origin with the liver and the gall-bladder. In this respect they are different from the urinary system, in which the ureter, pelvis of the kidney, and collecting tubules do not take origin from the same anlage as the parenchyma of the kidney, and they serve merely to carry off the excretory products of the kidney.

REVIEW OF LITERATURE ON THE BILE DUCTS

To obtain any idea of the histologic structure of the bile ducts one must consult books which have long since been swept by in the current of medical literature and are almost forgotten. The German anatomist Theile, in 1844, described certain glands which he found in the walls of the bile ducts. He examined specimens from the pig, the sheep,

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## ANATOMY OF THE BILE DUCTS

the horse, and from man. By injecting the ducts with cinnabar and oil of turpentine he was able to distend the glands so that they appeared on the surface as minute round clusters. He noted that in the pig, the sheep, and the horse the glands of the bile duct are very similar; they are numerous, and open into the cavity of the duct on all sides. In man, however, they are entirely different. In the large as well as in the small duct, which could be opened with scissors, he observed two opposite rows of openings crowded very closely together, but the glands were not so numerous as in the horse, the pig, and the sheep. In general they consisted of a large duct with short twists. On the periphery of the duct there were alternating small cæcal diverticula and short-stalked clusters. He compared them with the meibomian glands and said that the branches formed an anastomosing network in the wall of the duct.

Kiernan was perhaps the first to direct attention to the many small pouches, or parietal sacculi, which project out from the lumen of the duct.

Beale, in 1856, and again in 1889, published his views on the bile ducts. He said that in man the openings of the sacculi form two rows on opposite sides of the duct. The greater number, however, are openings not of sacculi, but of small irregular tubes which run obliquely in the coats of the ducts and anastomose with each other. The *vasa aberrantia* are irregular ducts with

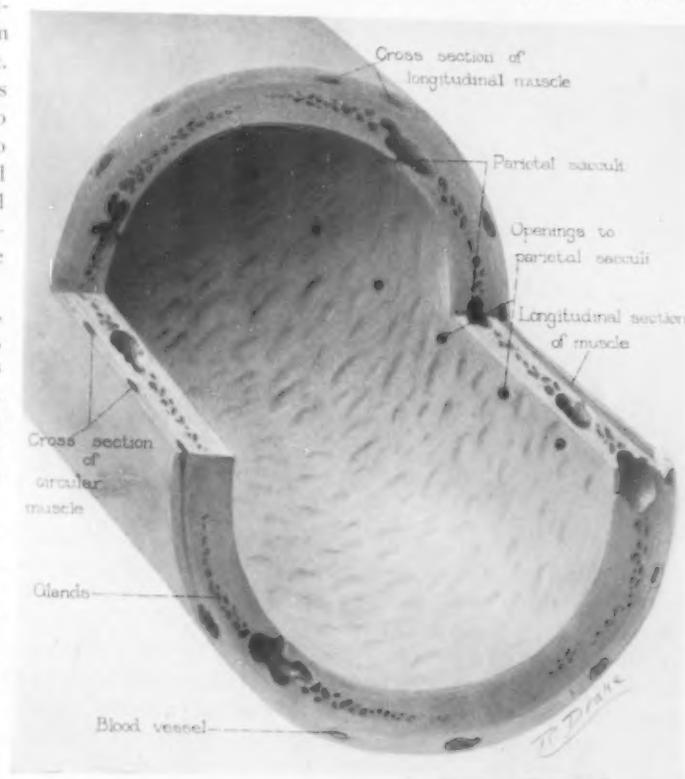


FIG. 1.—Reconstruction of the common duct showing the typical appearance of the mucous membrane, the parietal glands with their ampulla-like openings arranged in four rows, and the isolated bundles of circular and longitudinal muscle.

cecal pouches, and are most numerous in the transverse fissure of the liver. They are probably altered secreting tubes which at one time formed a part of the secretory structure of the liver. He did not believe that the glands of the ducts secrete mucus, because the bile of the rabbit in which the sacculi are almost absent contains as much mucus as that of the pig, in which animal they are very numerous. He looked on the parietal sacculi as diverticula in which the bile might be temporarily retained and inspissated, and therefore considered them little gall-bladders appended to the ducts.

Keibel and Mall stated that the embryologic development of the glands of the ducts had not been studied. They are considered to be epithelial pockets rather than mucous glands.

Riess, in 1863, said that the glands are most numerous in the hepatic duct, rarer

in the upper part of the common duct and in the lower cystic duct, and absent from the lower portion of the common duct. The largest are branched tubes with rounded terminations and the small ones are simply pockets. They are less developed in children than in adults.

The views of Beale have been recently revived by Sweet, who has brought forth experimental data to support his contentions. He noted that after removal of the gall-bladder in the dog there was an immediate rise in total blood cholesterol, which after a period of forty days returned to the normal level. He observed that the parietal sacculi which in the normal dog appear flattened, became elongated and hypertrophied after the

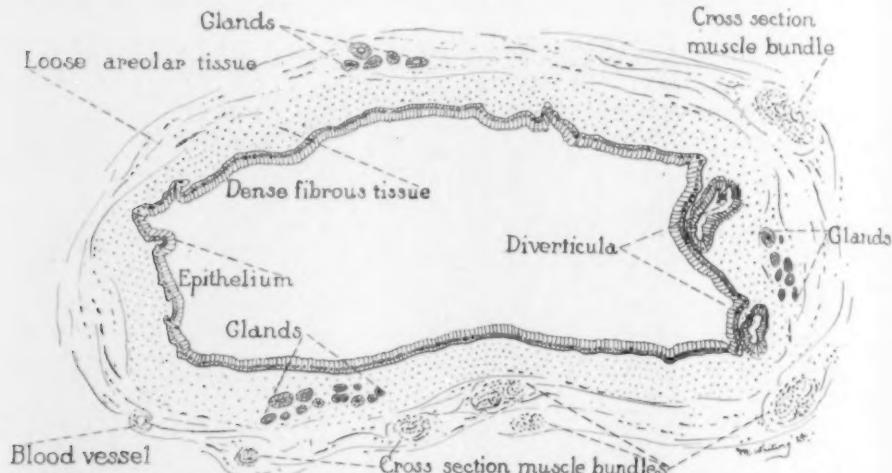


FIG. 2.—Cross-section of a bile duct showing the position and arrangement of the various structures found in the wall.

operation, coincident with the return of the blood cholesterol to the normal level. He believes that the numerous little gall-bladders appended to the ducts not only take over the function of the removed large gall-bladder, but also that pathologic processes which affect one extend to the other.

There is much in Sweet's conclusions to which exception might be taken. For instance, Judd and Mann have shown by experiments on dogs that the common duct dilates after cholecystectomy and that this dilatation is dependent on the intactness of the sphincter of Oddi. The enlargement of the parietal sacculi may be only a part of this mechanical dilatation. It has never been demonstrated that the parietal sacculi contain bile either before or after cholecystectomy.

In other words, in the human subject the walls of the bile ducts are richly supplied with epithelium-lined evaginations. These structures are variously spoken of as diverticula, parietal sacculi, and glands.

Another structure of the ducts which has received attention is the musculature. In 1888, Oddi described a sphincteric apparatus at the termination of the common duct which he believed was maintained in a state of tonic contraction by a nervous mechanism in the duodenum. My study did not include the sphincter of Oddi, and therefore this structure will not be further discussed. Regarding the musculature of the ducts themselves, there are conflicting observations. Beale says that in man there is no evidence of a distinct muscular coat. Matsumo concludes from his study that the common duct has a well-developed musculature only at the lower end. Muscle occurs in the duct above but is very irregular. He says that the common duct is a tube of connective tissue with a strong sphincter muscle at its mouth.

## ANATOMY OF THE BILE DUCTS

Hendrickson, in 1898, in a study of the musculature of the entire extrahepatic biliary system in man, found that longitudinal sections of the common duct revealed only a small amount of muscle. The fibres were longitudinal, diagonal, and transverse, and separated by much connective tissue.

Aschoff says: "All these distal bile passages (distal cystic duct, hepatic and common ducts) have practically no smooth muscle, being built from only connective tissue and elastic fibres, and are very rich in specific glands."

Aschoff's statement that the cystic duct proper begins at the termination of the true neck of the gall-bladder and does not contain the folds of Heister but resembles in structure the hepatic and common ducts is accepted. In any subsequent reference to the cystic duct the distal portion will be understood. The various theories regarding the variations of position and the function and dysfunction of the cystic duct in relation to the formation of gall-stones, as well as the question of a sphincter in this region, are not included in this study.

The physiology of the bile ducts is indeed very incomplete and mostly theoretical. Holmes believed that the glands of the ducts secrete mucus, and

Robinson says that

the glands of the cystic duct secrete fluid and bile salts. It was the opinion of Beale that the glands of the ducts do not form mucus but serve, as the gall-bladder does, to concentrate the bile. Sweet has shown that these glands in the dog hypertrophy after cholecystectomy, but on the evidence that he submits I cannot concur in his deduction that the glands take over the function of the excised gall-bladder. Rous and McMaster<sup>20</sup> conclude from their experiments that the gall-bladder and ducts exert opposite influences on the bile. The ducts do not concentrate and thicken it with mucus as does the gall-bladder, but dilute it slightly with a thin secretion of their own which is colorless and devoid of cholates and cholesterol. They do not state whether the secretion is a product of the glands of the ducts or of the lining epithelium. When the obstructed duct system was connected with the gall-bladder they found that the ducts, as well as the bladder, were filled with thick concentrated bile. Apparently these authors take it for granted that the thick bile in the ducts becomes concentrated in the gall-bladder and then passes out into the ducts.

Rost found dilatation of the ducts in all of his animals after cholecystectomy and divided them into two groups. In one group the duct was dilated and had a long functioning sphincteric part; the animal was continent for bile and the function of the sphincter like that in animals with a gall-bladder. In the other group the ducts were only slightly dilated, the sphincteric part short, and the animals not continent. From

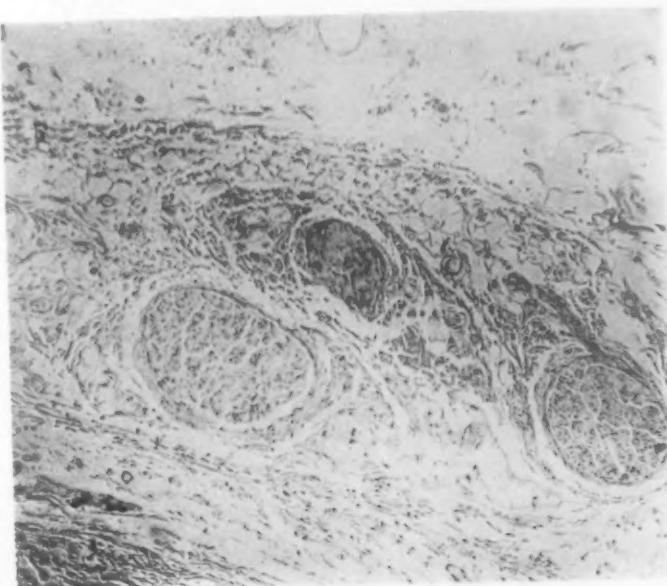


FIG. 3.—Cross-section of muscle bundles in the wall of the common duct. (X 60.)

the examination of necropsy cases he concluded that absence of gall-bladder function alone was not sufficient to lead to compensatory dilatation of the ducts, nor was dilatation of the ducts in the presence of an atrophied gall-bladder due to the absence of the bladder's function.

Klee and Klüpfel noted, as did Rost, that after cholecystectomy some dogs became continent and others incontinent, and that in the continent dogs the bile was thick like gall-bladder bile, whereas in the incontinent dogs it was thin and watery.

Kausch says that three factors enter into the nature and condition of the bile: secretion from the liver, secretion from the bile ducts, and resorption from the bile ducts.

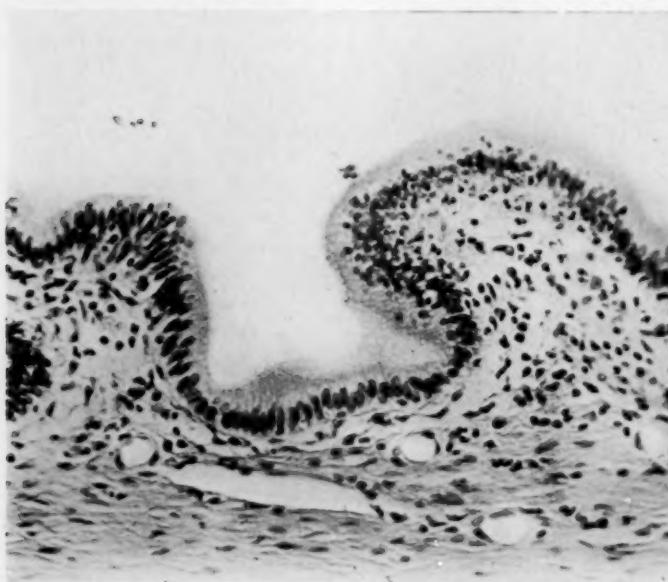


FIG. 4.—One of the numerous depressions on the interior of the duct with adjacent folds of mucous membrane. (X 120.)

pharmacologic stimulation of the vagus produced contraction of the gall-bladder and dilatation of the upper and middle portions of the common duct.

The present study was undertaken to determine the histologic structure of the extrahepatic bile ducts, not including the sphincter of Oddi, and to determine the nature of the pathologic processes that occur in the ducts. Only the ducts of man were studied.

*Method of Study.*—Specimens were obtained from one hundred routine necropsies, regardless of the ages of the subjects or the causes of death. In each case one or more specimens were taken from the hepatic, cystic, and common ducts and placed in formalin solution. The specimens were obtained as soon as possible after death. In the case of the common duct only sections from the supraduodenal portion were studied. Most of the specimens were examined both in the gross and under the dissecting microscope. Microscopic sections were then cut, some longitudinal and others transverse, and stained with haematoxylin and eosin. Some sections were stained for elastic fibres. Serial sections were made of a number of specimens.

It is apparently the unanimous opinion that the bile ducts have a secretion of their own. It is not specifically stated that it is a product of the glands of the ducts. Regarding the question of the resorption of fluid from the bile by the ducts as it occurs in the gall-bladder,<sup>21</sup> opinions are divided.

That the muscle tissue along the ducts plays a part in their activities seems to have been demonstrated by Westphal, who found that slight electric and

## ANATOMY OF THE BILE DUCTS

*Results of Study.*—Most of the ducts were normal, but in specimens from forty cases there were pathologic changes. The structure of the ducts did not vary with the ages of the subjects; the youngest was eleven and the oldest seventy-five years. According to my observations, the hepatic, cystic and common ducts have essentially the same histologic appearance. Therefore it seems best to combine my collective notes into a description of a normal bile duct, and then to describe the pathologic changes.

When the duct is laid open the internal surface presents a characteristic appearance and at first seems to be reticulated, but on closer inspection and under the dissecting microscope it is seen to be covered by minute pits or shallow depressions, some of which contain plugs of mucus (Fig. 1). The purpose of these pits is, apparently, to increase the surface area of the interior of the ducts. The appearance of the pits in ducts which have dilated because of obstruction will be described under pathologic anatomy.

Cross-sections of the duct show that the lining is covered with a layer of tall columnar epithelium. The nucleus of the cell is large, vesicular, well-stained, and situated at the base of the cell. The epithelium is similar to that which covers the rugae of the gall-bladder. The epithelial layer was found intact in comparatively few specimens, and in some instances it had disappeared within an hour after death. Its loss has been attributed to the action of the bile. During life the epithelium readily regenerates to replace any defects in its continuity. Horsley showed, in an experimental reconstruction of the common duct, that the new channel formed from transplanted tissue is quickly lined by epithelium which grows into it from the edges of the normal duct, but the reconstructed duct later becomes almost completely obliterated in spite of the presence of lining epithelium. The process of fibrous obliteration takes place in the connective-tissue layer of the duct. This layer is found just beneath the lining epithelium and contains considerable elastic tissue, as was shown by special stain. The connective-tissue layer is thick and compact, and there can be no question but that it is the chief strength of the wall of the duct. The outer coat of the duct is composed of a loose layer of areolar connective tissue in which are found blood-vessels, lymphatics, and muscle (Fig. 2). I did not make special efforts to identify nerve tissue.

In spite of the opinions of others relative to the rarity and even absence of muscle tissue in the ducts, my observations showed that the bile ducts of the human subject are supplied with a well-developed musculature. It was almost constantly present in all specimens and was particularly evident in the cross-sections. Serial sections demonstrated

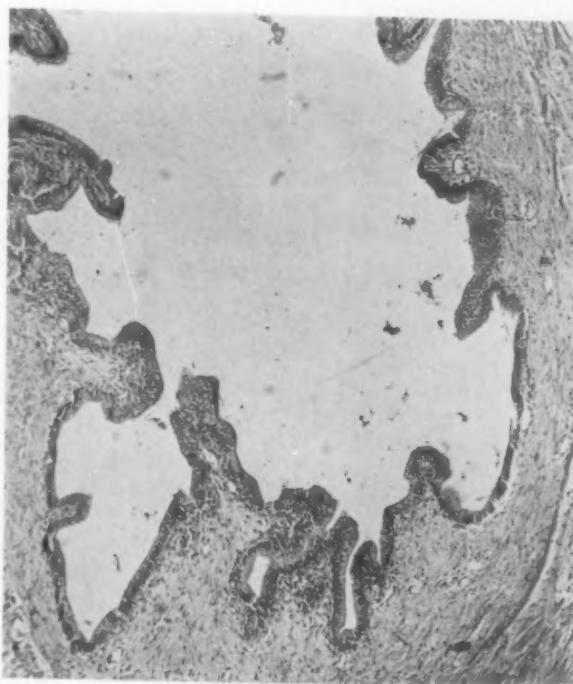


FIG. 5.—Portion of a cross-section of a bile duct showing folds of mucous membrane and a typical so-called parietal saccule. (X 60.)

its presence along the course of the duct. The muscles are situated in the outermost layer of the wall and are made up of good-sized, isolated, oval bundles of unstriped fibres (Fig. 3). There are longitudinal and circular bundles, the former being the larger and better developed. A cross-section will usually reveal three or four large round bundles about equidistant in the periphery of the duct and separated by connective tissue which may contain several smaller bundles. I have not been able to find a description of peristalsis in the human bile duct, but from the anatomic standpoint it is possible, as it is seen in the ureter.

It should be pointed out that the majority of the pits which appear on the internal surface of the duct are not the openings of glands, but are shallow epithelium-lined

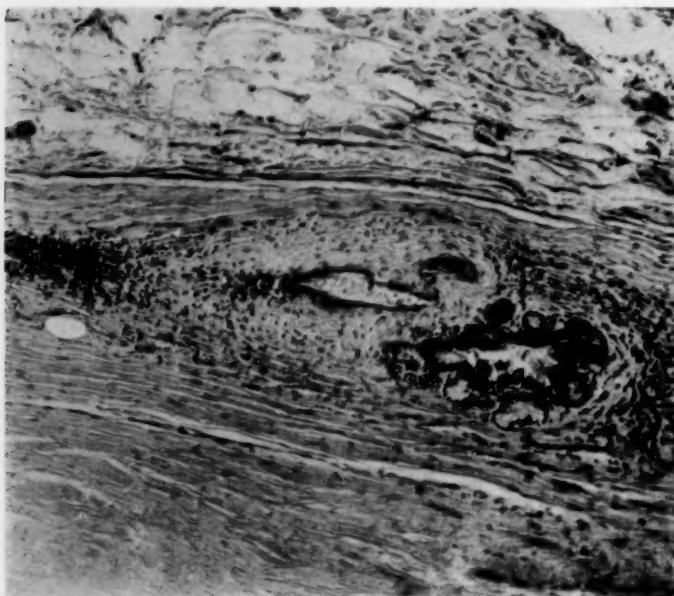


FIG. 6.—Nest of glands surrounded by marked inflammatory changes. (X 120.)

regularity and seem to be arranged in four equidistant rows around the circumference of the duct (Fig. 1). Emptying into the sacculi are numerous glands which ramify in the wall of the duct, chiefly in longitudinal and circular directions, and seem to form almost a complete glandular layer around the duct. Near the sacculi the glands seem to be simple tubes but near the outer wall of the duct, where they are most numerous, they assume more the character of mucous glands and the acini are usually arranged in nests. In contrast to the frequent absence of the lining epithelium of the duct, caused by the action of the bile after death, the epithelium of the sacculi, tubes and glands are invariably intact. This observation helps to support the belief that the sacculi and glands do not retain bile. When their course is traced through serial sections of the duct, they appear to originate in acini in the outer wall of the duct from which tortuous tubes course through the walls to empty in common with other tubes into an ampulla-like opening which in turn communicates with the lumen of the duct. From the structure and arrangement of the diverticula and glands, it seems just as impossible for bile to be retained in them, as it would be for the contents of the duodenum to be retained and resorbed in Brunner's glands. In other words, the current is from the glands into the duct.

There are many variations in the appearance of the glands in apparently normal ducts. They are usually well developed and made up of cells similar to the lining epithelium of

depressions between folds of mucous membrane (Fig. 4). Occasionally these depressions take on the appearance of pouches (Fig. 5). However, after numerous microscopic sections have been studied, and the development of structures as brought out in serial sections of the duct has been observed, it is evident that besides the pits there are deep sacculi or diverticula which communicate by narrow openings with the lumen of the duct. These diverticula occur with definite

## ANATOMY OF THE BILE DUCTS

the duct. Sometimes they seem to be almost atrophic and the cells small and flat. Glands were present in all specimens of ducts examined.

An accidental finding was the presence in several specimens of accessory pancreatic tissue in the wall of the common duct.

### PATHOLOGIC ANATOMY OF THE BILE DUCTS

In a search through the text-books and recent literature no account of the pathologic anatomy of the ducts was found. The late post-operative complications of cholecystitis in which the common duct is sometimes constricted or completely obliterated by fibrous tissue can be explained only after an understanding of the early changes in the ducts. In discussing the pathologic anatomy of the cystic duct, Else says that the mucous glands may harbor infection and that the secondary changes in the duct following inflammation may cause hydrops and empyema of the gall-bladder.

Disease of the gall-bladder was associated with the diseased ducts in most of the forty cases. No attempt will be made here to correlate the histologic and clinical significance of the lesions in the ducts, but merely to describe the changes as they appeared in the specimens. The epithelium is very delicate and is usually absent in post-mortem specimens but not as a result of desquamative catarrh.

Inflammation in the duct is usually characterized by lymphocytic infiltration, an increase in connective tissue, and changes in the appearance of the glands. The infiltration by small round cells is sometimes seen just beneath the surface, but more often it is either diffused through the wall of the duct or confined particularly to the area around the glands (Fig. 6). In the later stages of inflammation an increase in connective tissue causes the wall to thicken, and the glands are often encased by a dense wall of fibrous tissue. From their characteristic distribution in the wall of the duct, it can be readily understood that inflammation in or around the glands would cause disease of the duct in its entire circumference. The fibrous tissue laid down during the

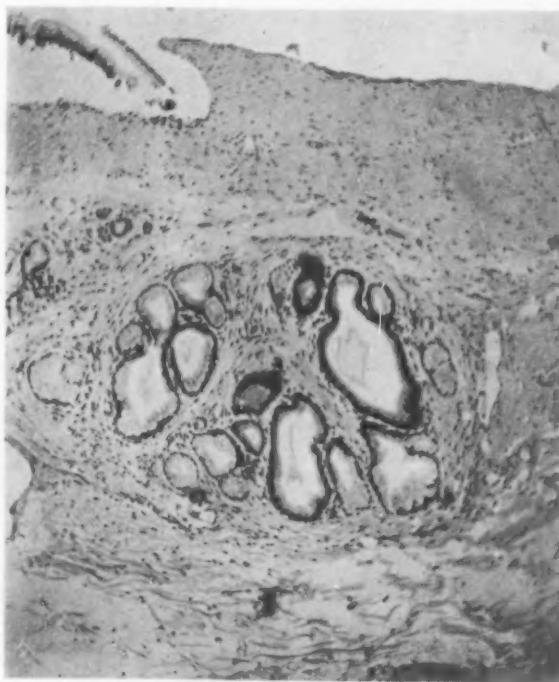


FIG. 7.—A group of cystic acini in the wall of the hepatic duct. (X 60.)

repair of a severe grade of inflammation changes the duct into a rigid inelastic tube. In some specimens the wall of the duct is thick and composed almost entirely of fibrous tissue. When the inflammation and fibrosis are localized in a short segment, a stricture of the duct may occur. A more extensive process may be followed by obliteration of a large portion of the duct. The glands, besides being surrounded by a zone of lymphocytes, are often dilated and cystic with flattening of their lining cells (Fig. 7). Sometimes the glands were small and atrophic as if choked by fibrous tissue.

Even in uncomplicated cholecystitis the hepatic and common ducts show evidence of inflammation, but, as might be expected, the cystic duct shows the most marked changes (Fig. 8). The importance of the effects of infection in the wall of the cystic duct should be borne in mind whenever cholecystostomy for cholecystitis is considered as an operation of choice.

Dilatation of the common duct may be caused by obstruction, or it may be the result of infection sufficient to destroy the function of the gall-bladder, or it may follow cholecystectomy. Examination of the duct in the



FIG. 8.—Cross-section of cystic duct from a case of cholecystitis showing folds of mucous membrane like those of the gall-bladder and dilatation of the intra-mural glands with round-cell infiltration. (X 60.)

last two conditions may throw some light on the question of compensatory function of the duct. The cystic and common ducts which were markedly dilated as the result of obstruction low in the common duct are shown in Fig. 9. The ducts have been laid open, and it will be noted that the cystic and common ducts are identical in gross appearance. The pits on the surface of both ducts are plainly evident and it can readily be seen that these pits are mere shallow depressions between folds of mucous membrane and certainly are not dilated nor hypertrophied pouches or parietal sacculi.

#### DETAILED FINDINGS IN PATHOLOGICAL SPECIMENS

**CASE I.**—A woman, aged thirty-seven, died following a radical operation for carcinoma of the right breast with glandular involvement. The patient had never been jaundiced. At necropsy the gall-bladder contained forty-two stones and the mucosa had a strawberry appearance. The common duct was markedly dilated and contained

## ANATOMY OF THE BILE DUCTS

seven stones. Sections were made of the ducts. These showed lymphocytic infiltration throughout. Just beneath the surface of the common duct there was a marked inflammation; the glands showed proliferation and were dilated and filled with mucus. The epithelial lining of the duct was intact (Fig. 10). There was no evidence of dilated sacculi in communication with the lumen of the duct.

**CASE II.**—A woman, aged forty-six, gave a history of gall-stone colic. Operation revealed a stone in the common duct and a fistulous opening between the gall-bladder and duodenum. The stone was removed from the duct and a rubber catheter inserted for drainage. The cholecystoduodenal fistula was closed. Death occurred five days after operation. Necropsy revealed a small contracted gall-bladder which was buried in adhesions to the under surface of the liver. There was extreme dilatation of the common duct. Microscopic sections of the duct revealed thick walls with marked lymphocytic infiltration. The glands were cystic.

**CASE III.**—A woman, aged sixty-three, came for examination because of repeated attacks of gall-stone colic. Operation revealed acute cholecystitis and stones in the common duct. Cholecystectomy was performed, three stones were removed from the common duct and a rubber catheter inserted into the duct for drainage. The patient died four days after operation. At necropsy a stone was found in one of the larger intrahepatic ducts and also a stone in the common duct at the juncture of the cystic duct which had ulcerated through from the cystic duct. The common duct was markedly dilated, and measured 2.5 cm. in circumference. The microscopic sections of the duct showed inflammatory changes and great proliferation and dilatation of the glands just beneath the lining epithelium.

**CASE IV.**—A woman, aged forty-nine, gave a history indicative of cholecystitis. At operation an old empyema of the gall-bladder was found and there were stones in the common duct. Cholecystostomy and choledochostomy were performed. Death occurred five days after operation. Examination of the biliary tract revealed one large and many small stones in the lower end of the common duct just above the ampulla. All the extrahepatic ducts were dilated and the common duct measured 3.5 cm. in circumference. The intrahepatic ducts were not dilated. The microscopic sections showed that the walls were thick, oedematous and infiltrated with lymphocytes. Very few glands were seen.



FIG. 9.—Interior of the cystic and common ducts which were markedly dilated as the result of obstruction.

CASE V.—A man, aged seventy-two, came for examination complaining of stomach trouble. He was found to have a carcinoma of the stomach which in the röntgenogram appeared to be operable. The patient died following resection of the stomach. At necropsy stones were found in the gall-bladder and in the common duct. The gall-bladder was small and contracted as a result of chronic infection, and the common duct was markedly dilated and contained stones just above the ampulla. Microscopic examination of the ducts showed that the walls were thick, oedematous, and infiltrated with round cells. The glands of the ducts were only moderately dilated.



FIG. 10.—Section of common duct from a case of stone in the common duct, showing marked proliferation and dilatation of glands just beneath the surface, with evidence of inflammatory reaction in the tissues. (X'60.)

Microscopic sections of the ducts showed that the walls were thickened by fibrous tissue, the glands dilated, and the mucous membrane thrown into folds.

These six typical cases show the presence of inflammatory changes in the ducts in association with infection in the rest of the biliary tract. While the cases illustrate extreme features of biliary disease with active clinical symptoms, many examples could be cited in other cases of ancient and apparently quiescent disease of the gall-bladder, in which less marked but still well-defined pathologic changes appeared in the ducts. It was very exceptional to find the ducts normal in the presence of an obviously diseased gall-bladder. It does not necessarily follow that involvement of the ducts is secondary to that of the gall-bladder, although it is the most plausible explanation. It is possible that the two may be affected simultaneously. The possibility of an ascending infection in the wall of the duct from the duodenum must be also borne in mind, particularly when there is obstruction to the drainage of the ducts by a stone.

CASE VI.—A man, aged sixty-five, gave a history of repeated attacks of severe colic in the right hypochondrium. He was definitely jaundiced and appeared to be very ill, so that it seemed best to keep him under observation for a time until surgical intervention could be more safely undertaken. He became progressively worse and died without having been operated on. Necropsy showed that the gall-bladder had been almost completely destroyed by infection. The extrahepatic bile ducts were markedly dilated and their walls thickened. The ampulla of the common duct was dilated, swollen and oedematous. There was no demonstrable obstruction in the ducts and they were free from stones.

## ANATOMY OF THE BILE DUCTS

The gall-bladder, because of its peculiar form and position, is unable to deal adequately with infection, and once infected readily becomes reinfected, because the ability to empty its contents has been seriously impaired; at best it is a diverticulum that drains poorly. On the other hand, the ducts should speedily recover from infection because of their excellent drainage, unless there is obstruction by stone or a focus of infection in another part of the duct system as in the gall-bladder.

A characteristic feature of the inflammatory changes in the ducts is the dilatation of the glands. They become distended with mucus which they pour into the duct. They never contain bile. Irritation of the glands is followed by overproduction of mucus. Others beside these six cases were examined in which the gall-bladder had been rendered functionless by chronic infection. A careful study of the ducts in these cases did not reveal any structural changes that might be considered compensatory for the loss of function of the gall-bladder. The question of compensatory function of the ducts after cholecystectomy can be solved for man only by the gross and microscopic study of the ducts after the removal of a normal gall-bladder. From the evidence before me, which is based on a comparison of normal ducts with those in cases of advanced disease of the gall-bladder, it would seem that the theory is not supported by the facts.

*Discussion.*—There can be no doubt that, from the embryologic and anatomic standpoints, the gall-bladder is a part of the duct system. There is also a very evident similarity in minute structure, especially in the type of lining epithelium. Langenbuch, who performed the first cholecystectomy in man in 1882, observed that gall-bladder bile is concentrated, and Rous and McMaster<sup>21</sup> were able to measure this function of the gall-bladder in the dog. It is probably safe to assume that the lining epithelium of the gall-bladder is responsible for its concentrating activity. It is well known that the gall-bladder and ducts secrete mucus. In the case of the former, this function is also probably carried on by the surface epithelium and perhaps aided by the glands of Luschka. In the case of the ducts, mucus is formed mainly in the parietal glands. These similarities between the gall-bladder and ducts, and the observations of Klee and Klüpfel that duct bile may be concentrated after cholecystectomy, seem to justify the belief that the ducts are also able to concentrate bile, although this function may be insignificant compared to the greater function of the gall-bladder. White bile occurs in the obstructed ducts from which the gall-bladder has been excluded, probably because the concentrating activity of the ducts, being handicapped by a very limited surface area, cannot keep pace with the excretion of bile from the liver. The residual bile present in the duct after cessation of the flow, disappears through absorption and is replaced by mucus.

The dilatation of the ducts which follows removal of the pressure regulatory function of the gall-bladder, either by disease or by operation, is probably mechanical in origin, because it does not occur when the sphincter of Oddi is not intact. The ducts do not dilate when there is incontinence of the

VERNE G. BURDEN

sphincter which accounts for the relatively normal size of the ducts, sometimes seen with cholecystitis and occasionally after cholecystectomy. The findings in this group indicate that absence of the function of the gall-bladder is not solely responsible for dilatation of the ducts and also that the ducts do not take over the function of the ablated gall-bladder.

SUMMARY

The hepatic, cystic (distal part), and common bile ducts are identical in structure. They are lined by a layer of tall columnar epithelium which covers a surface made uneven by numerous shallow depressions. The epithelium rests directly on a thick compact layer of elastic connective tissue which makes up most of the thickness of the wall and on which the tensile strength of the duct is mainly dependent. The outside coat of the duct is composed of a loose layer of areolar tissue in which are found bundles of unstriped muscle, blood-vessels, and lymphatics.

The walls of the ducts are richly supplied with glands which are situated for the most part in the outer coat, but the ducts of the glands, coming together from all directions, finally empty into ampulla-like openings which are arranged in a regular manner around the duct and communicate with its lumen. There is no evidence of true parietal sacculi or diverticula.

The ducts are provided with a well-developed musculature which is composed of isolated longitudinal and circular bundles situated in the outer layer of the duct and separated from each other by connective tissue. The muscle does not form a compact layer but is arranged as a loose network.

The most frequent pathologic changes in the ducts are those of inflammation. Cholecystitis is nearly always accompanied by infection in the walls of the ducts. The lesions are those of the usual chronic inflammatory type, characterized by lymphocytic infiltration and the production of fibrous tissue. The glands may retain infection and aid in its dissemination through the duct. The glands respond to the irritation by an overproduction of mucus and become dilated and cystic. The process of repair is attended by the formation of fibrous tissue which results in a thick and inelastic tube.

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## ANATOMY OF THE BILE DUCTS

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## SPONTANEOUS RUPTURE OF THE SPLEEN

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OSCAR O.—Private Company "A," 15th Tank Battalion, was admitted to the Station Hospital, at Fort Benning, Georgia, from command, on the evening of April 25, 1924. He was aged twenty-four years; white; single; born and raised in Alabama; has never been to the tropics; habits as to alcohol, abstemious, never drunk; no drug habits; smokes pretty steadily.

Family history negative.

Past history: Had measles in 1915. Has never had any serious illness, always well and healthy. No malaria, typhoid, influenza, rheumatism, throat trouble, or other ill health. No indication of stomach disturbance. Was raised in the country and a small town. Worked at home on the farm. Has been in the army four years, all of which time was spent in Georgia or Alabama, with the exception of a few months in Florida. No gunshot wounds or other casualties. Denies venereal history. He is on duty as a cook, with no heavy work.

Present illness: Patient states he had finished his duties for the day as a cook, and after eating a light supper of bread, a canned pear and some jelly, was standing on the porch, smoking a cigarette, when he was taken with a sharp pain in the upper part of his belly and lower left chest. He felt nauseated and giddy, vomited once. Walked over to his barracks, a few hundred yards away, and laid down on his bunk for a while; felt he was getting worse, so walked to hospital about a quarter of a mile, and was admitted to Medical Service and put to bed. On admission—a well developed young man, age twenty-four years, weight 180 pounds. He complains of acute pain over upper abdomen, more on left and over left side of chest. Respiration is painful. The pain extends into the left shoulder and down his arm and forearm. Says his hand feels numb on the outer side. Feels nauseated. His general condition is one of shock. The skin is pale and clammy from cold perspiration, the mucous membranes pale, pulse 112 by stethoscope; 58 by wrist; blood-pressure 80 over 50; heart is negative. No râles or rub heard in chest, which is negative. Temperature 97; respiration 20.

The abdomen is fairly soft, practically no distention. There is pain and tenderness on deep pressure over epigastric and splenic areas, with slight increase in dullness over latter.

With rest in a heated bed and shock enema of whiskey and coffee, the patient reacted somewhat, became more comfortable, and showed slow but progressive improvement during the next forty-eight hours. Laboratory reports showed urine negative; stools negative for parasites, ova or blood; blood count red cells, 3,900,000; whites 16,200 haemoglobin 70 per cent.—Differential: small mononuclears 14; large mononuclears 2; polymorphonuclears 84. Blood culture shows no growth and is negative for malaria. On the 27th the count showed 4,000,000; 11,600, and 76.

Wassermann taken at this time was reported later as negative.

X-ray of chest states lungs appear clear, left leaf diaphragm appears slightly elevated.

On the morning of the 28th, the symptoms and physical signs showed a recurrence of pain, or pallor, air hunger, feeling of giddiness. Some gaseous distention of belly appeared, with dullness in left flank.

The patient was at once transferred to the operating room, with diagnosis of internal hemorrhage probably from ruptured spleen.

Under gas-oxygen anaesthesia, a four and one-half inch incision was made over the middle of the left rectus single muscle parallel to its fibres, the lower end extending to a

## SPONTANEOUS RUPTURE OF THE SPLEEN

point about 1 inch below the umbilicus. On opening the peritoneum, a large amount of free and clotted blood was liberated. The spleen was immediately sought and located. On palpation it felt moderately enlarged and extensively lacerated. It was free of adhesions, surrounded by a large blood clot, and easily delivered through the abdominal incision. The vessels and peritoneal ligaments were clamped, ligated, and the spleen removed. The capsule and splenic tissue had been torn through and through in an irregular jagged fashion. Some of the larger blood clots were removed from the abdomen, normal saline solution poured into the belly and left there, and the belly closed in layers.

A transfusion of citrated blood was given on the table, and again later in the ward, together with saline per rectum and intravenously.

Subsequent history shows a fairly smooth and gradual but incomplete recovery. Stitches were removed on the eighth day, wound healed and dry. Patient up in wheelchair, feeling rather peaked, on the fourteenth day; walking about feebly on the twenty-first.

The patient ran a sustained temperature for about six weeks, 100 to  $102\frac{1}{4}$  in the afternoons; 98.6 to 100 in the mornings—at the end of that time the temperature was normal, and remained so except for an occasional 99.

The pulse during the febrile period showed a corresponding excitement, with maximum of 114. For the last week it varied between 72 and 80.

The blood-pressure on the 7th of May was 100 over 60; on the 11th, 115 over 75.

Cultures made from abdominal blood clots showed no growth in 48 hours. Cultures from the blood were sterile on repeated examinations. Examinations for malarial organisms were always negative.

On May 1, three days after operation, patient complained of recurrence of pain in left shoulder and arm—the next day it had disappeared. He has had occasional mild recurrences since then.

Through several weeks there was complaint of pain in the right lower quadrant, and in the left upper belly. There was a tendency toward gaseous abdominal distention and constipation, which required repeated enemata, pituitrin, and various cathartics. He was practically free from these symptoms for ten days preceding his discharge on furlough the 8th of July. At that time he was rather listless in his movements, had a poor color, and said he tired easily on exertion. He had regained much of his original weight. About the end of July, 1924, he returned from sick furlough which he had spent at his home in Andalusia, Ala. He stated that he suffered considerably during his furlough with dull pain and ache almost constantly in abdomen, just to the right of the umbilicus, always more aggravated at night. His appetite was fairly good over this period of time, but his bowels would not move regularly, and it was necessary to resort to laxatives every two or three days. He slept poorly all the while, felt nervous and weak, just as if he could not put one foot before the other.

After about twenty days of his furlough were spent, he decided to return to the hospital for treatment. He was admitted July 27, 1924, and on admission complained of night cough, which caused him pain in the right lower quadrant, and a feeling as if something was being torn up. The pain, apparently, was more confined to McBurney's region at this time (July 30), and the patient was observed for appendicitis for a couple of days on his developing soreness in that region. Blood examination made at that time (July 30, 1924) showed 4,344,000 red; 7,450 white; polymorphonuclears 65 per cent. No malaria found. In a couple of days the soreness just previously mentioned disappeared somewhat. His general condition of malaise, anorexia and mental depression remained unchanged.

On August 15, 1924, in addition to the special diet which the patient had been getting since August 3, fresh beef bone-marrow sandwiches were added. Bid. Blauds pills and I.Q.S. Ac. The patient relished the sandwiches, and his mental attitude became somewhat

## H. S. HANSELL

more cheerful. Blood count taken August 21, 1924, showed increase of about 700,000 red cells per cu. mm., with 10 per cent. increase in haemoglobin. Patient would interest himself in novels and both his mental and physical condition seemed improved.

August 25, 1924, patient complained of pain in eyes after reading. Examination made showed negative results. Since August 25 the patient has been more depressed and has headaches off and on all the time. Appetite is quite good but bowels are not regular, and laxatives are necessary. He says he doesn't know how he feels. Since admission patient has gained three pounds. He now weighs one hundred and fifty-eight.

Following table shows weekly blood examination and result of G. I. Series taken August 8, 1924.

Result of Gastro-intestinal Series taken on Private Oscar Olmstead, and also weekly blood examination.

### X-ray taken August 8, 1924:

The stomach is of the steer horn type and appears atonic. It is not freely movable. Duodenal cap clearly outlined and fills evenly. Peristalsis sluggish; six hours: Stomach empty, head of meal at sigmoid flexure; 24 hours: Colon practically free of meal. Appendix not visualized. Cæcum fairly fixed. Barium enema: entire colon filled in six minutes, descending colon redundant. Sharp angle at splenic flexure. Cæcum bulbous and ileocæcal valve is incompetent.

Impressions: Iliocæcal incompetency, cæcum held immovable by adhesions. Appendix pathology probable.

7-24-24—	13,700 white, 22 Small mon., 5 large, poly., 73.
7-30-24—	4,344,000 red, 7,450 white, Small mon., 26, large 9, trans. 1, poly., 65.
8-14-24—	3,576,000 red, 7,880 white, Hemo., 80%, Small mono., 42, large 6, trans. 2, poly., 50.
8-20-24—	4,208,000 red, 9,000 white, Hemo., 85%, Small mono., 22, large 10, trans. 4, poly., 64.
8-31-24—	4,230,000 red, 7,200 white, Hemo., 90%, Small mono., 20, large 7, trans. 2, poly., 62.

On September 26, 1924, the patient was transferred to Walter Reed General Hospital for further observation and treatment. Upon his admission there he complained of general weakness and nervousness, pain in right lower quadrant and constipation. His weight was 157 pounds, and the blood-pressure 100/63. The tonsils showed a chronic follicular tonsillitis, and there was some tenderness over MacBurney's point upon deep pressure.

The urine and stools and sputum were negative. The blood count was as follows:

<i>Blood Count</i>	
Red corpuscles	..... 5,150,000
White corpuscles	..... 15,500
Hæmoglobin	..... 90%
Small monos.	..... 29
Large monos.	..... 1
Eosinophiles	..... 8
Polys.	..... 70

The patient's appearance and conduct in the ward were those of a man in mental distress. He appeared to take little or no interest in what went on about him. He says he feels "down and out," disheartened, and "low in his mind." He complains of pain in region of heart, which extends up into left shoulder; headaches, which have troubled him ever since the operation, and sometimes pain in right lower quadrant. He says he is so weak that walking only a short distance makes him short of breath and wears him

## SPONTANEOUS RUPTURE OF THE SPLEEN

out. His appetite is not good and he is sleepless and constipated. Weight is now 155 pounds, and the blood-pressure, 120/80.

Blood counts at intervals of about ten days were as follows:

Red corpuscles .....	3,800,000	4,250,000	4,920,000
White corpuscles .....	12,500	12,500	12,500
Hæmoglobin .....	75%	90%	90%
Small monos. ....	32	18	47
Large monos. ....	1	6	3
Eosinophiles .....	0	0	0
Polys. ....	67	76	50

There was no further change in his condition, and as it was apparent that he would never be fit for duty as an able-bodied soldier, he was discharged on certificate of disability on January 7, 1925.

The spleen was sent to the Laboratory of the Surgeon General for pathological report and museum preservation. Following is a copy of the report:

*Specimen from Spleen.*—Received from Station Hospital, Ft. Benning, Ga.

Received spleen measuring 8 x 9 x 15 cm. weighing 375 gms. which shows numerous parallel linear fractures which apparently completely cross the organ. A small percentage of these show fungating masses which are apparently produced by the mechanics of the spontaneous rupture. The pulp of the spleen shows a moderate increase of all connective tissue and a massive increase of the pulp consisting almost entirely of large mononuclear cells, without constant presence of cytoplasm. This increase of cells is accompanied by a rare mitotic figure, to be expected in a cellular increase of this kind, yet not suggestive of any malignancy.

There are moderate quantities of black pigment mostly contained in large phagocytes and suggestive of an old malaria. There is a moderate hyalin degeneration in the subintimal areas of all small blood-vessels. There is an extensive epithelioid and round-cell infiltration of a fairly recent and active character of all medium-sized veins. Two of these medium-sized veins show a rupture through the most active areas of infiltration. This rupture suggests more of a traumatic aspect from occlusion of venous return rather than a degenerative process. A tentative count made on blood in the vessels in the spleen indicates a high leucocytosis the increase of which is chiefly due to large mononuclears of a myelocytic character. This coupled with the sudden rise in percentage of large mononuclears as noted in the clinical report suggests a careful observation of this case for lymphatic leukaemia.

*Summary.*—The pigment in this case suggests malaria which is the commonest cause of spontaneous rupture of the spleen. The large mononuclear element suggests further observation for lymphatic leukaemia. The recent and ancient degenerations in the blood-vessels would necessitate elimination of syphilis in this case. The traumatic character of the rupture of the medium-sized veins above mentioned could have been caused by twisting of the vascular pedicle which could have occluded veins without occluding arteries and so produce a mechanical rupture.

Medical literature contains many references to rupture of the spleen. Excluding the traumatic type, there remains a fairly large number of so-called "spontaneous ruptures." With the exception of a very few cases in the latter group, there has always been some recognized accompanying pathology, such as malaria, typhoid, septicæmia, kala-azar, undetermined fevers, rheumatism, influenza, appendicitis, tuberculous kidney, carcinoma of stomach, dysentery. The present case seems to come under the small group of purely

## H. S. HANSELL

spontaneous ruptures of unrecognized etiology, with no accompanying or complicating diseased condition.

Traumatism offers no explanation. There was no blow or violence from without, no muscular strain from within. Moreover, in this case the clinical course leads one to believe that there was a primary incomplete rupture, followed in about forty-eight hours by a complete and widespread tear. As the case was in bed with absolute rest and restricted diet during this interval, traumatism either external or internal, is ruled out. The second rupture can be attributed to the continued action of the unrecognized factor that caused the first rupture.

A congested spleen following a heavy meal does not apply. It had been six hours since an average meal had been eaten, and an hour and a half since a very light one.

The pedicle of the spleen was not twisted at the time of removal. The spleen was in its normal position, though enlarged (3758 m., 8 x 9 x 15 cm.). Malaria excluded, so far as the life history and repeated blood examinations can exclude it, although the abundant pigment present in microscopic section is quite suggestive of this condition. There has been no further evidence of an early lymphatic leukaemia. The blood Wassermann was clearly negative.

The literature on splenic ruptures shows the "occasional" appearance of the following conditions: Loss of weight, polyuria, thirst, thyroid enlargement, lymphatic enlargement and bone pains, blood changes, all of which were absent in this case; and pyrexia of several weeks' duration, abdominal pain and tenderness, prostration, constipation, and pain in the left shoulder, all of which were present. The latter symptom calls for special consideration as a diagnostic sign of ruptured spleen with internal hemorrhage. It has been attributed to the association of the fourth cervical nerve with the phrenic. Its presence was noted in one case of Connors and Downer, one of Willis, one of Fauntleroy, three of Metcalfe and Fletcher, and one of Diehl. Blood changes were not entirely absent. The laboratory frequently reported the red cells as fragile and staining poorly; but there was no blood picture suggesting any blood or systemic disease.

## CONCLUSIONS

1. Sharp pain in the left shoulder and arm, occurring in a case showing signs of internal hemorrhage, is quite suggestive of a ruptured spleen.
2. Immediate splenectomy with blood transfusions reduces the mortality materially.
3. Spontaneous rupture of the spleen may occur in the absence of clinical evidence of associated disease of other organs, in the presence of an apparently sound and able-bodied person.

## FASCIAL BANDS AS SUPPORTS TO RELAXED FACIAL TISSUE

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VARIOUS types of excisions of skin have been made for lifting tissues relaxed by age. In such patients, no deformity from facial paralysis exists, and lifts are made purely for the relief of signs of age. Such lifts, effected by excision of skin only from the temporal region, or from the side of the face in front of the ear, are not adequate to overcome the effects of facial paralysis. In seventh nerve paralysis, other measures must be used to increase effects, although there is no objection to using these technics of skin excision in such cases as adjuncts to other surgical measures.

In 1913, Kirschner (in *Beitrage zur klinischen Chirurgie*, vol. lxxxvi, p. 5), writing up the present status and future promises of autoplastic fascial transplants, gave credit to Peyer as the first to use a strip of living fascia for the establishment of a union between the frontal muscle, and the upper lid in ptosis.

After discussing this subject, Kirschner took up the consideration of facial paralysis, due to seventh nerve injuries. He called attention to the difficulty of nerve anastomosis, emphasizing the serious nature of operations involving dissections in the cervical triangles, and objected to these operations as very uncertain. He pointed out that they destroy forever and completely the function of another nerve. Personally, I do not believe that the uncertainty of nerve anastomosis, is as objectionable as the rather long wait for restoration of function after operation.

The destruction of another nerve is not important provided the operator is judicious in his selection for anastomosis. If we eliminate traumatic cases,



FIG. 1.—Excisions may be made entirely in the temporal region or may be extended above or behind the ear. More subcutaneous tissues may be taken than that immediately under the skin excised if the operator elects.

CHARLES CONRAD MILLER

in which extensive sloughing has followed severe injury, and relations of normal tissues are grossly disturbed by cicatrization, nerve anastomosis operations are not very uncertain but are usually successful when the proper time is allowed for regeneration of the nerve after the union has been made.

The second group of methods discussed consisted of muscle transplantation operations. Tomoin transplanted half of the sterno-cleido-mastoid muscle into the paralyzed half of the face. Lexer took part of the masseter. Both operations require considerable dissection, and after these operations, annoying irrepressible associated movements are said to occur.



FIG. 2.—In women the excision may be extended downward in front of the ear. The strip of tissue should be freed from the skin layers before it is drawn down through the subcutaneous tissues.

tissue as possible at the corner of the mouth. However, even so, the wire cut through partly and destroyed a part of the originally excellent results.

Momberg therefore recommended hardening the tissues at the corners of the mouth by preliminary alcohol injections, or inserting a thick wire parallel to the border of the upper lip and letting it heal in, and then at a second operation fastening the looped wire from above, to it. This complicated, decidedly, an otherwise simple operation.

Kirschner said, in substance, "When one recalls the good and lasting results of treating ptosis with strips of fascia, one naturally thinks of using this material here also. It is obvious that an autoplastic transplanted tissue which becomes intimately united with its new surroundings, can be separated from its new home only with great force, contrary to a metal wire which

Since the corner of the mouth often drooped again in spite of the original over-correction, he fastened the loop above, not only to the soft parts, but around the zygoma, and took pains to include as large a piece of

## SUPPORTS TO RELAXED FACIAL TISSUE

always remains a foreign body. In addition, a metal wire gradually oxidizes, and breaks, especially here in the cheek where frequent movements take place."

Kirschner recommended the following procedure after general anaesthesia, as he found infiltration oedema objectionable. He made a free incision along the upper border of the zygoma, and passed a properly bent sound behind the zygoma through the soft parts to the corner of the mouth, and close to the corner of the mouth he pushed the point out through a counter-incision. He used a strip of fascia lata about 2 cm. wide which he pointed out should be considerably longer than double the distance between the two skin incisions. This strip, he recommended be drawn behind the zygoma, through the subcutaneous canal, and passed subcutaneously 3 cm. medially, along the upper margin of the lip, and here drawn out through a third incision. From the end of the zygoma, a dressing forceps is pushed subcutaneously towards this third incision, and with it the strip of fascia drawn to the zygoma incision. The two ends of the strip of fascia are here sutured under such tension, that the ring of fascia around the zygoma and soft parts of the upper lip, fold up the corners of the mouth to the degree desired.

Kirschner did not advise undertaking appreciable over-correction, since experience showed him that transplanted strips of fascia did not stretch, and cutting of tissues did not follow.

Burk, in 1916, commenting on the possibilities of autoplasic uses of fascia lata (*Beitrage zur Klinischen Chirurgie*, vol. c, p. 427), emphasized the difficulties of operation for facial paralysis when nerve anastomosis was attempted after injuries resulting from gunshot wounds of the bones of the face with extensive destruction of soft parts, such conditions making hypoglossal or accessory nerve anastomosis impossible in many cases. He preferred free transplantation of a strip of fascia for raising the corner of the mouth, to muscle plastics involving the masseter or temporal muscles. Owing to the continual pull upward upon the fascial strip, Burk split the ends of the fascial strip into four pieces, anchoring one end above the angle of the mouth, the other at the angle of the mouth, and the remaining ends in the middle of the upper and lower lips, by which technic, he claimed to secure a



FIG. 3.—The large upholsterer's needle is drilled after temper has been drawn and notch formed to hold suture material so that the silk carrier can be drawn down and held while needle is returned to temporal region by pushing the sharpened butt upward through the tissues.

CHARLES CONRAD MILLER

more solid fixation of the strip of fascia, and a better cosmetic result, as he raised not only the corner of the mouth, but the entire left side of the face.

Fascial strips are easily secured from the lower outer aspect of the thigh. By subcutaneous dissection long strips may be obtained, through a single short transverse incision. Such fascial strips can of course be passed down from the temporal region, but there is no reason why we should not utilize the dense subcutaneous tissues of the temporal region and not entirely detach strips formed by dissection in this situation. When we go to the temporal region for our connective-tissue strip to effect a facial lift, we should go above the hair-line. Incisions made in the hair, when subsequently sutured, leave scars which do not show. While we know excisions of skin only from the temporal region, or from in front of the ear, will not overcome a facial paralysis deformity, we do know that it can help some. Those of us who have used this method of excision in cases where there is a mere sagging of the tissues from age, know that we can get satisfactory results in certain cases.



FIG. 4.—The connective tissue strip is drawn down to a point near the angle of the mouth. The free end is then drawn upward through the tissues and anchored in the silk.

skin from above and in front of the ear. If, therefore, we make excisions in these regions, and instead of excising skin and subcutaneous tissues, we cut such tissues into the form of a long strip, after removing the outer skin layers of the strip, we have a firm dense strip of tissue which can be passed downward toward the corner of the mouth without making an open wound upon a conspicuous part of the face.

The most convenient way to pass such strips downward to the corner of the mouth is with a large upholsterer's needle. A loop of silk is threaded into the eye of the needle, and the eye is so made that the silk loop will be held at the end of the eye nearest the point of the needle. The butt of the needle is sharpened somewhat so that when the needle point has emerged near the corner of the mouth the silk carrier is caught and then before the butt

## SUPPORTS TO RELAXED FACIAL TISSUE

of the needle emerges from the skin it is pushed back upward into the temporal wound. The needle is pushed down from the temporal wound through the deeper tissues. After the point emerges from the angle of the mouth, and the silk carrier has been caught with a hook, the butt of the needle is returned to the temporal wound more superficially. By this procedure, the silk carrier is carried through the tissues in the form of a complete loop.

With the silk loop, the fascial strip is drawn down to the region of the corner of the mouth, and is then drawn upwards to the temporal wound.

No wound is made upon the face except that made by the rather large needle used in carrying the silk down to the region of the corner of the mouth. Such needle punctures heal without leaving appreciable scars.

After the fascia has been drawn down and back to the temporal wound, it should be firmly anchored in place with fine silk.

These silk stitches cause no irritation, are not subject to infection, and insure anchoring the strip permanently.

It is important that the dermal layers be cut away before the strip is buried in the tissues, but we should not expect it to become firmly anchored in connective tissue, the free ends should always be secured with sutures which will not absorb.

After the fascial strip is securely anchored, the skin wound in the temporal region is closed. By such closure the defect in the skin is drawn together and the tissues of the face lifted somewhat.

If one wishes, a subcutaneous fascial strip may be taken from the temporal region or from the auricular region without sacrificing the skin, or one may take a small amount of skin only and by retracting skin edges, cut in the form of a strip, a much larger segment of subcutaneous tissue.

When it is desired to pass one strip to the angle of the mouth, and another just below the malar eminence only, a short strip may be taken by



FIG. 5.—In the completed operation the skin wounds are drawn together where there is much tension the sutures are reinforced in the buttons.

CHARLES CONRAD MILLER

extending the crescentic incision behind the upper part of the ear. Through such skin incision, a fascial strip may be cut which can be drawn through the subcutaneous tissues to emerge beneath the malar eminence.

When a strip is drawn through at this point, one should exercise care not to bring the fascial strip too close to the under surface of the skin so that when backward and upward traction is made, a distinct dimple does not form at this point, as a sharp depression will be conspicuous in this situation.

When the fascial strip is drawn down to the region of the mouth, the natural dimple point may be selected as the point of emergence for the needle, in which situation dimpling is unobjectionable.

## COMPENSATORY LENGTHENING OF THE FEMUR IN CHILDREN AFTER FRACTURE

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THREE years ago we<sup>1</sup> reported a series of 31 cases of fracture of the femur in children and emphasized the restitution of the shaft practically to normal, and its compensatory lengthening. A short time previous to this,

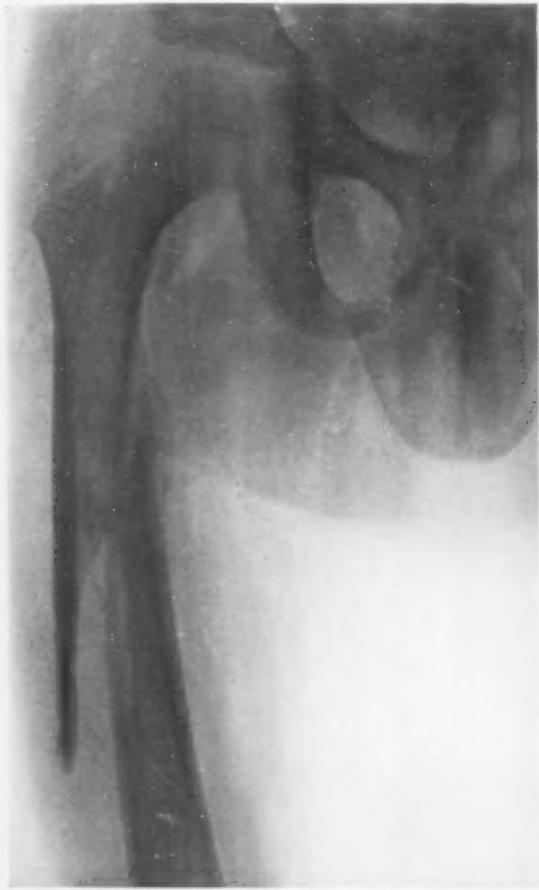


FIG. 1.—Case I. Four weeks after oblique fracture upper third.

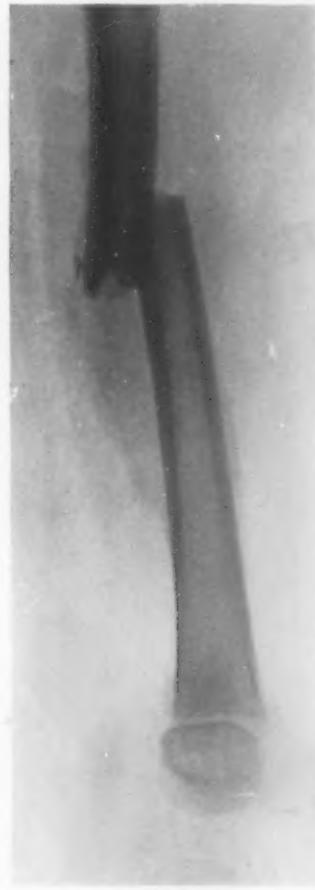


FIG. 3.—Case II. Three weeks after transverse fracture middle third.

Truesdell<sup>2</sup> reported overgrowth of bone in 5 cases of fracture of the femur. Since then compensatory growth has been observed by several authors. Our first publication included a series of 31 cases. Fifteen more cases have been

WARREN H. COLE

observed since then. We were able to follow up and observe only 20 of this total of 46 cases \* for more than one year.

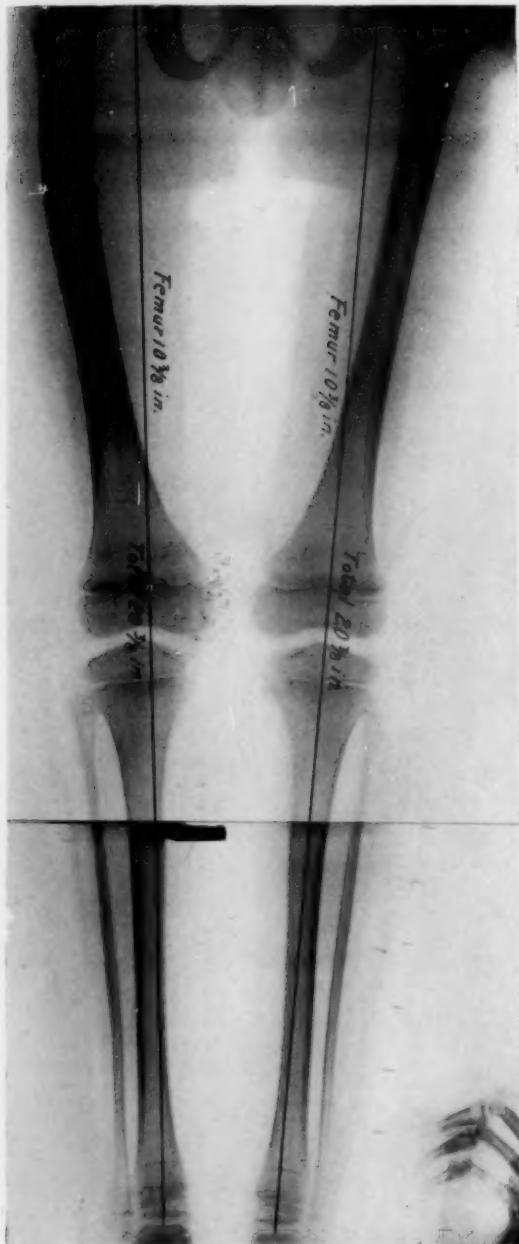


FIG. 2.—Case I. Two years after fracture. Measurements reveal no shortening.

\* This series was taken from the service of Dr. M. B. Clopton of the St. Louis Children's Hospital, and credit is due him for advice and suggestions.

METHOD OF RE-EXAMINATION

David<sup>3</sup> has outlined an accurate method of determining shortening and growth, in an article in which he reports a gradual compensatory growth

## COMPENSATORY LENGTHENING OF THE FEMUR

in the majority of cases of fractures of the femur in children. He stresses the need of placing the patient on a hard table with anterior superior spines of the pelvis on the same level and with the heels equidistant from a line running from the umbilicus through the symphysis pubis to the level of the internal malleolus of the tibia when taking measurements or röntgenograms.

To eliminate or detect any source of error in measurements from the X-ray plates, we superimpose a rule with a metal marker at each inch of its length, parallel to the shaft of femur and tibia on each side about two inches above the film.<sup>†</sup> (See Figs. 2, 4, and 6.) By taking precautions we feel that the comparative measurements of each shaft of the femur on the X-ray film represents a very accurate comparative measurement and distinctly more accurate than measurement between bony landmarks on the child's body.

A very interesting example of overgrowth of bone has been observed by Brooks and Lehman<sup>4</sup> in cases of bone involvement by Recklinghausen's Neurofibromatosis.



FIG. 5.—Case III. Four weeks after oblique fracture middle third.

<sup>†</sup>If there is any rotation of the pelvis or difference in distance from each shaft to the plate, there will be a discrepancy in the measurement of distance between an equal number of metal markers on the X-ray film on the two sides. Care is also taken when making röntgenograms that a line drawn perpendicularly from the tube to the film is equidistant from the shafts of the two femurs, and also from the rules with metal markers on each side. As would be expected, it was found that the actual measurement between each marker on the end of the film was greater than the distance between them in the central portion of the film,  $11/10$  inches and  $11/16$  inches, respectively. It was found, however, that the distance between 15 markers was exactly equal to the distance between an equal number of markers alongside the other femur directly opposite.

WARREN H. COLE

The following patients represent a series which were studied with unusual care in regard to measurements on the röntgenogram. It should be empha-

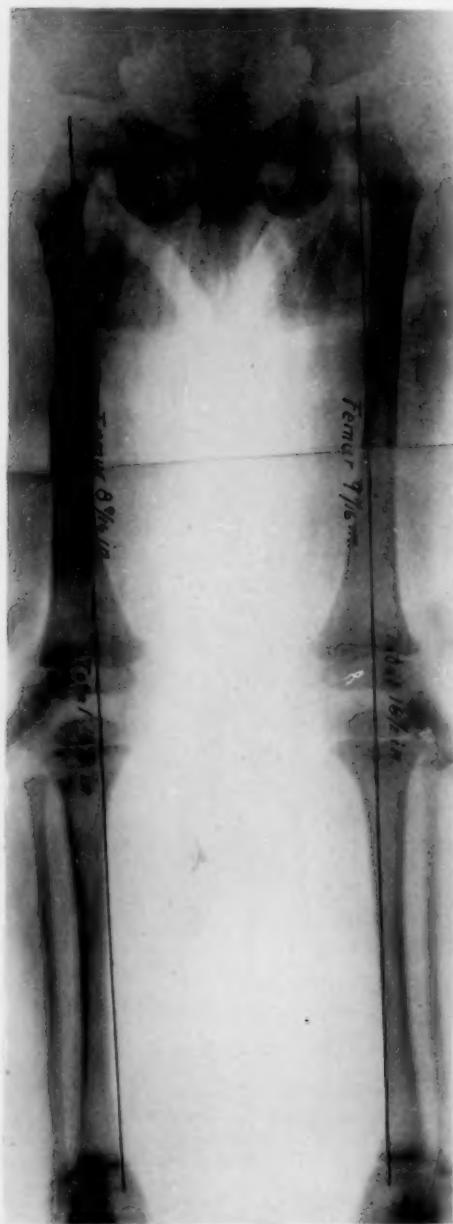


FIG. 4.—Case II. Two years after fracture. Shortening of femur was  $\frac{1}{2}$  inch, but difference in total length of femur and tibia was only  $\frac{1}{8}$  inch.

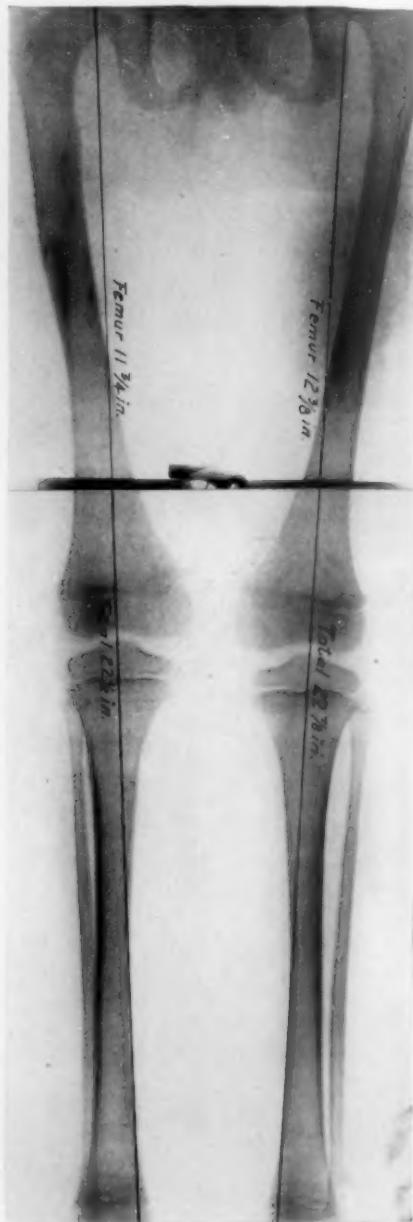


FIG. 6.—Case III. One year after fracture. Shortening of shaft of femur found to be  $\frac{3}{8}$  inch, but shortening of combined measurement femur and tibia was only  $\frac{1}{8}$  inch.

sized that the amount of shortening discovered on the röntgenogram slightly exceeds the actual bone shortening or measurement on the living subject. All

#### COMPENSATORY LENGTHENING OF THE FEMUR

of these röntgenograms were taken with the tube at a distance of 40 inches from the film. Assuming the shaft of the bone to be about 2 inches from the film, it can be estimated with the aid of geometry that the measurement on the

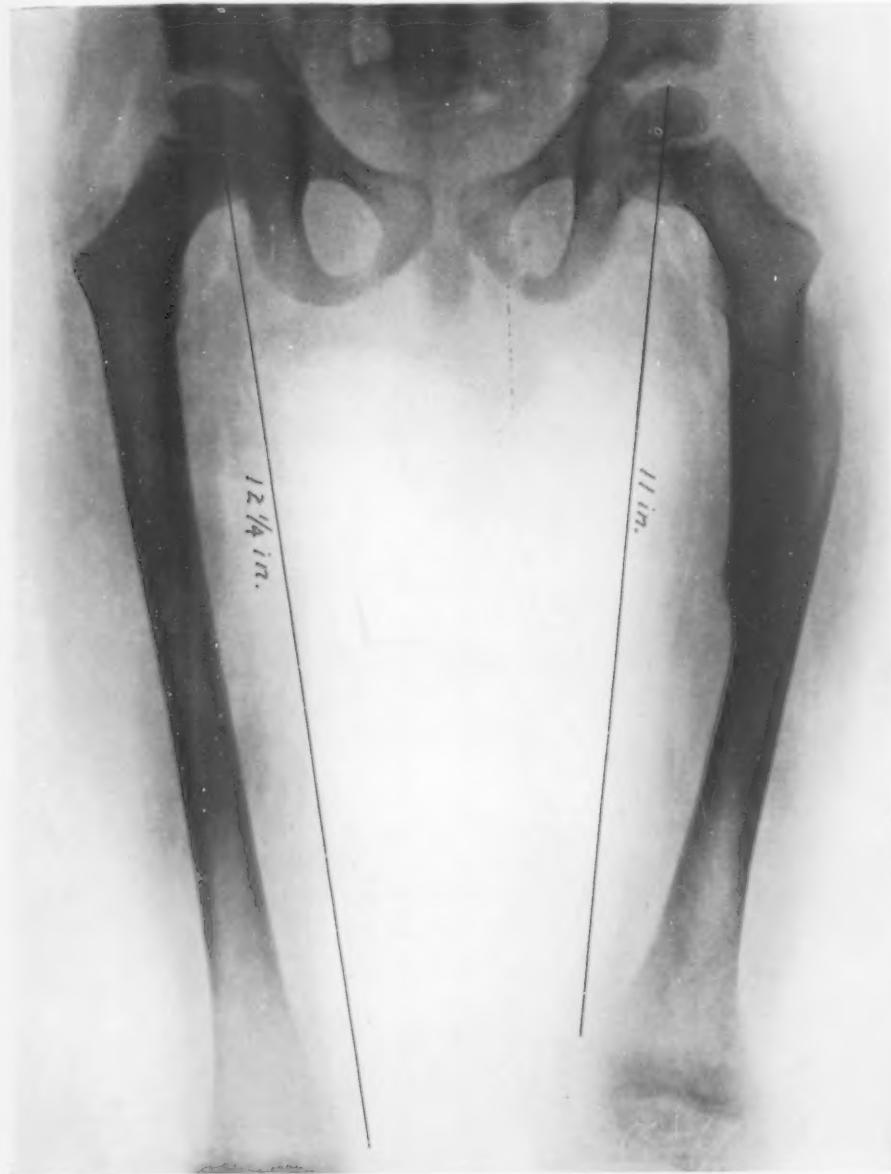


FIG. 7.—Case IV. Three months after oblique fracture upper third. Considerable difficulty in treatment on account of inability to correct the marked overriding which was present at time of fracture. Shortening measured  $1\frac{1}{4}$  inches on the röntgenogram.

film should exceed the actual measurement of the living subject by 5 per cent. Needless to say, all measurements were made with a wooden rule, and the same one used throughout.

WARREN H. COLE

CASE I.—Boy (E. G.), four years of age. Oblique fracture at junction of middle and upper third right femur. Treatment consisted of overhead traction for three and one-half weeks followed by plaster cast for two weeks. Had  $\frac{5}{8}$  inch shortening before

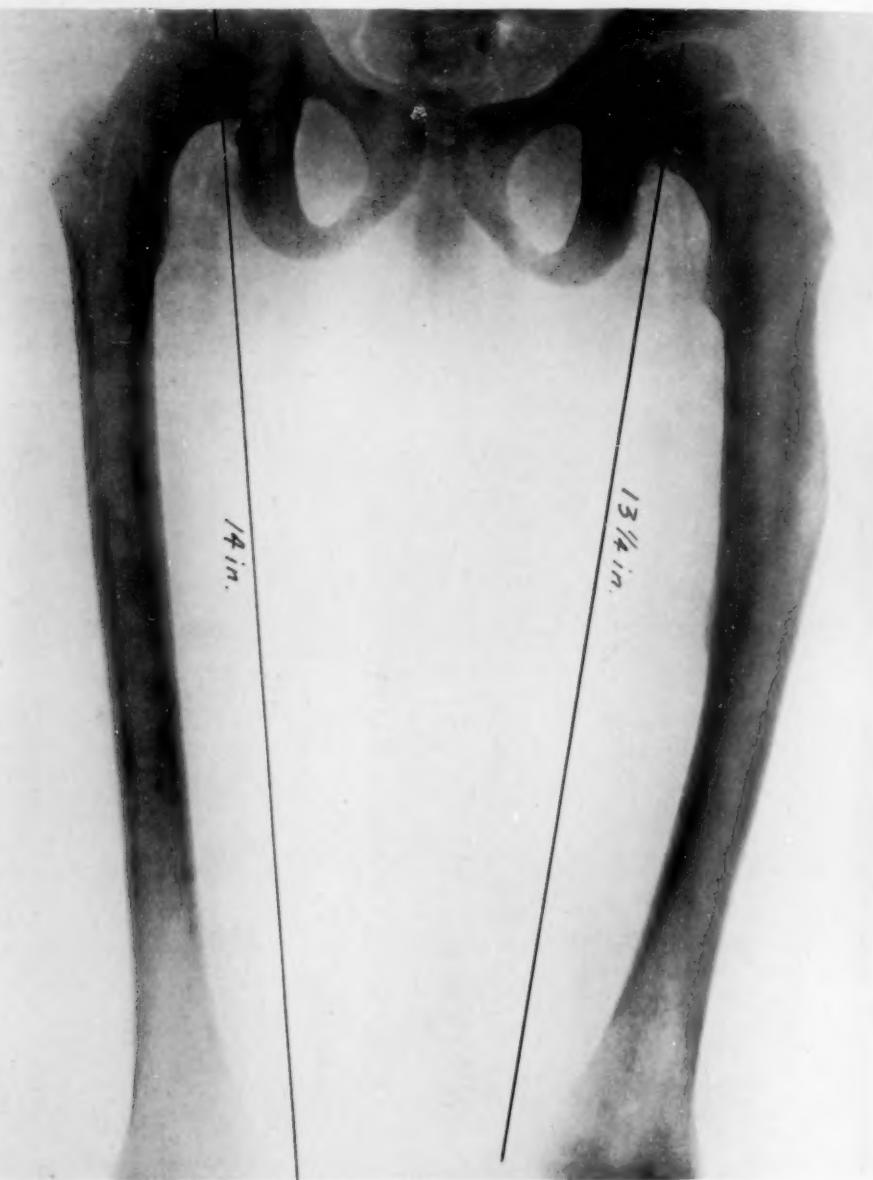


FIG. 8.—Case IV. Fifteen months after fracture. The shortening has been reduced from  $1\frac{1}{4}$ -ins. to  $\frac{1}{4}$ -in. treatment started, and  $4/8$  inch at time of removal of cast, six weeks after injury. Seen two years after injury. No shortening demonstrable by any method of measurement, including use of röntgenogram. (See Figs. 1 and 2.)

CASE II.—Boy (G. S.), three years of age. Transverse fracture middle third right femur. Treated by overhead traction for four weeks and plaster case for two weeks.

## COMPENSATORY LENGTHENING OF THE FEMUR

Had one inch shortening before treatment and  $\frac{1}{4}$  inch shortening at the end of six weeks. Returned in two years. Measurements on the living body revealed practically no shortening—possibly  $\frac{1}{8}$  inch. Measurements of the entire femur and tibia on the X-ray film revealed a shortening of  $\frac{1}{4}$  inch. Measurements of the femur alone, however, revealed a shortening of  $\frac{1}{8}$  inch, indicating that compensatory growth may take place along the entire extremity as well as the femur. The right tibia measured  $\frac{1}{8}$  inch longer than the left. (See Figs. 3 and 4.)

**CASE III.**—(E. D.), boy, nine years of age. Oblique fracture of right femur at junction of its middle and upper third. Treatment consisted of overhead traction for four weeks and plaster cast for two and one-half weeks. Shortening before treatment was  $1\frac{1}{4}$  inches. When the cast was removed, shortening between the anterior superior spine and internal malleolus, trochanter and external malleolus, measured  $\frac{3}{4}$  inch. When seen one year later, the shortening had decreased to  $\frac{1}{2}$  inch. Combined measurements of the femur and tibia on the röntgenogram revealed a shortening of  $\frac{1}{8}$  inch, whereas the shortening of the femur alone measured  $\frac{1}{8}$  inch. The right tibia measured  $\frac{1}{8}$  inch longer than the left. (See Figs. 5 and 6.)

**CASE IV.**—(G. S.), boy five years of age. Oblique fracture of right femur in its upper third. Treatment consisted of overhead traction with Thomas splint to give support for bands to correct deformity. After four weeks, union was firm and plaster cast was applied. Measurements on the röntgenogram revealed  $1\frac{1}{4}$  inches shortening, shortly after removal of the cast. Fifteen months afterwards, the shortening found by measurements on a röntgenogram had been reduced to  $\frac{1}{4}$  inch. (See Figs. 7 and 8.)

### SUMMARY

It has been noted that compensatory lengthening will take place in the majority of cases of fracture of the femur in children. The amount of lengthening varies in each patient and is not dependent upon any form of treatment. It has been our experience when treating fractures of the femur in children that overhead traction offers the most comfortable and efficient method for restitution to normal function. Burdick<sup>5</sup> and Siris who have observed compensatory lengthening, favor the use of Bryant's frame with



FIG. 9.—Shaft of femur one year after operative reduction with the aid of a Lane plate. Note extreme anterior bowing.

extension, but are inclined to believe the traction serves more as a factor of immobilization than as a method of decreasing overriding. Nevertheless, many cases have been observed in which the overriding was decreased considerably. It is desirable to get good alignment of fragments, and perhaps more important than to overcome all of the shortening, provided some portion of the ends of the fragments are in contact. It has also become apparent that operative reduction of fracture of the femur of children is very rarely indicated since deformity is so completely eradicated within two or three years after fracture, even though the fracture be transverse. Operated cases have given much less satisfactory end results because of bowing of the shaft after the Lane plates have been removed. (See Fig. 9.) The only patient which was treated with an intramedullary peg, returned two months afterwards with a refracture at the site of the previous fracture. Incidentally this was the only case of refracture that was known to have occurred in this series of cases. (See Fig. 10.)



FIG. 10.—Patient suffered a transverse fracture, middle third, on account of extreme overriding was treated by application of an intramedullary bone peg. Above röntgenogram reveals refracture, which occurred at site of original fracture eight weeks after operative reduction, and resulted from a minor fall. Röntgenogram two years later revealed healing without deformity, marked thickening of bone. Slight shortening still exists, no limp present.

#### CONCLUSIONS

1. Compensatory lengthening will take place in the majority of cases of fracture of the femur in children.
2. The location of compensations may be found in the tibia as well as femur.
3. Rarely is there indication for operative reduction.
4. Abnormal bowing of the shaft serves as one of the greatest factors of deformity and of disability, and in this series was seen only in operated cases.

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## ACTIVE MOTION IN THE TREATMENT OF FRACTURES\*

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THERE are just and insistent economic demands for reductions in the durations in immediate and in extent of ultimate disabilities inevitable with customary treatments of fractures. Remedies are suggested by two axioms: Restitution of function is the chief therapeutic obligation. Recovery of function is more prompt and more complete as inhibitions of function are less complete and prolonged. The requirements, therefore, are to curtail the degrees and durations of immobilizations. Means to fulfil therapeutic requirements and to meet economic demands can be developed by adapting practices to conform more directly with natural methods that foster the resistance, defense, growth and repair of bones.

Man has been trying to record his observations and experiences for some thirty centuries, beset the while with difficulties and uncertainties. Rarely has he recorded only what he saw, infrequently he saw what he has recorded, and the few reliable records have failed but occasionally either to be ignored or misinterpreted by others. Hence it has ever been easier, and usually safer, for the less experienced to accept unquestioned the teachings of alleged constituted authorities. This is particularly true of dogmas promulgated with the

FIG. 1.—June 12, 1924. Anteroposterior view showing fractures and faulty positions of fragments.



\* Read before the American Surgical Association, May 6, 1925. Radiographic and experimental work from the Laboratory Department, Columbia Hospital.

supporting evidence of statistics which everyone can understand and none may believe. Man's credulity on the one hand and his faculties for organization on the other have resulted in the collection of real and potential authorities into units. If they are successful, the units automatically acquire authority, develop infallibility, preach ex-cathedra dogmatism and attempt to monopolize every line of endeavor, including efforts toward progress. During the past thirty decades, schools, guilds, associations, colleges, partnerships and clinics have been created. A brief survey of the history of fracture therapy and its

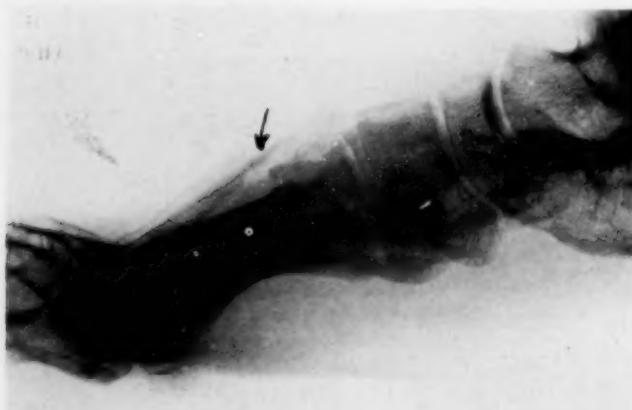
development under these influences will disclose reasons for widespread and growing dissatisfaction.

In the first epoch, extending up to Simpson, Pasteur and Lister, knowledge was restricted to gross anatomy and mechanics. Operations were few, anaesthetics relatively unknown

FIG. 2.—October 10, 1924. Lateral view showing results from active motion after four months when bony union had become firm. Absence of atrophy and of excess callus formation, improved positions of fragments and preserved arch are noteworthy.

and notions of repair chimerical. Surgeons' attention was largely centred upon fractures. Excellent closed methods were devised to reappose fragments, many of which are useful to-day. External means were found to maintain reapposition with immobilization. It was noted that solidification resulted after periods that varied with the bone affected, the type of fracture and the age and condition of the patient. The doctrines of the first period were: To obtain accurate closed reapposition of fragments; to maintain reapposition with external fixation, and to continue reapposition and fixation immobilized until bony reunion had occurred.

The second period ended with the standardization of radiotherapy and radioscopy. It was dominated by the doctrines of morbid anatomists. Increasingly frequent open operations provided some conceptions of repair. The microscope disclosed cell arrangements associated with normal growth and the productions of bone after injuries, but failed to interpret the practical significance of the sequence of healing processes. Many methods and much paraphernalia were devised to permit more accurate reapposition of fragments and to fix them by artificial impactions or by internal supports. All sorts and conditions of contrivances were evolved to secure immobilization. Some of them discredit the apparatus man has invented and employed throughout the ages to produce those exquisite discomforts that have obtained desirable



## ACTIVE MOTION IN TREATMENT OF FRACTURES

testimony from the uncommunicative and led divers sinners to profess recoveries from religious and political diseases.

The opening of broader and more fertile fields for surgical interventions diverted the attention of general surgeons from fractures. Specialists appeared who contemplated skeletal defects exclusively and were given the care of fractures in the larger and more influential medical centres. The patients, because of the enthusiastic care of their bones by bone specialists, came to take rather a secondary position. The mechanics of fracture treatment were developed so as to fulfil most real or fancied requirements for reapposition, fixation and immobilization. And still there was insufficient progress. The one opportunity to provide better care lay in a more accurate understanding of natural healing processes. The microscopists came to the rescue. They discovered good little cells that lived in holes and made bone, and called them osteoblasts; also bad big cells that lived in bone and made holes, and called them osteoclasts. They advised wisely that the activity of the osteoblasts be encouraged and those of the osteoclasts be discouraged, but failed to indicate the method to accomplish these ends. These were priceless additions to knowledge, but not greatly to the advantage of unfortunates with bones to mend. They were, however, more serviceable than routinism based upon statistics, because two suggestions were implied, *viz.*, to treat individuals and not fractures, and to treat them in accordance with natural reparative processes. Nevertheless physiologic requirements were all but ignored. Man determined the conditions against which Nature must labor to effect repair.

The doctrines of the second period were: To obtain accurate reappositions of fragments by closed or open procedures; to maintain fixation by external



FIG. 2a.—October 10, 1924. Anteroposterior view showing results from active motion after four months when bony union had become firm. Absence of atrophy and of excess callus formation, improved positions of fragments are noteworthy.

*or internal* appliances, and to continue reapposition and fixation immobilized until bony reunion had occurred.

The third period opened inauspiciously for progress in the treatment of fractures. Medical authorities had agreed since the beginning on just what treatments were required. Man's ingenuity had provided means to meet the requirements. Fractures were being treated in medical centres by specialists who were devoting their lives to amelioration of skeletal defects, who thought

of nothing else in fact. Others, less gifted, who were also treating fractures, need only follow their perfect practises to avoid the evil ways of the unorthodox which corrupt results.

However, other influences became effective. Competitions in peace and war developed appreciation of values of man and woman power. With this appreciation came a growing recognition of handsome is that handsome does and that prompt functional recoveries were more to be desired than servitude to orthodox routine. Man's position in the biologic scheme and his subservance to biologic laws were established. Therewith a belated medical concept was evolved: All biologic knowledge can be applied in obtaining a

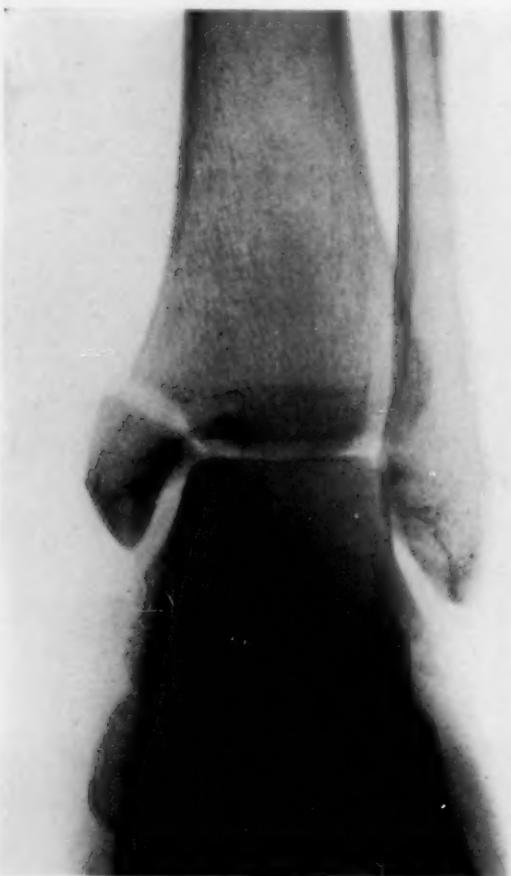


FIG. 3.—August 24, 1922. Anteroposterior view showing position of fragment.

clearer understanding of disease and no means to a better comprehension of disease will fail to afford more effective therapy. Radiography showed that some unrecognized fractures went on to remarkably good functional recovery when treated only with active motion restricted by pain. Radiography also proved that accurate repositions and firm fixations of fragments were not only unessential to perfect recoveries of function, but also that such repositions and fixations were no assurance of satisfactory recoveries. Experience taught the wisdom of neglecting fractures in attempts to avoid fatalities in infirm patients. The bone healing sometimes was astonishingly good, indeed

## ACTIVE MOTION IN TREATMENT OF FRACTURES

the results could be better than had routine methods been employed. Occasionally a person denied all assistance, because of isolation, would suffer from so severe an injury as a compound fracture of the femur and would recover. Survival demanded active motion; pain controlled it. The healing could be equal, even superior to that obtained under the care of adept surgeons. Thus came gradually the proofs of facts. Reapposition of fragments, their fixation and immobilization, are unessential to excellent recoveries under certain conditions, but under those conditions active motion is a constant factor. Willem and Delrez demonstrated the beneficent influence of active motion in preventing ankylosis and hastening recoveries from severe acute arthritis and peri-articular fractures caused by war injuries. Rollier proved that active motion is an essential element in permitting functional recoveries from bone and joint tuberculosis.

Another series of observations have been made in the clinics and experiments Nature has

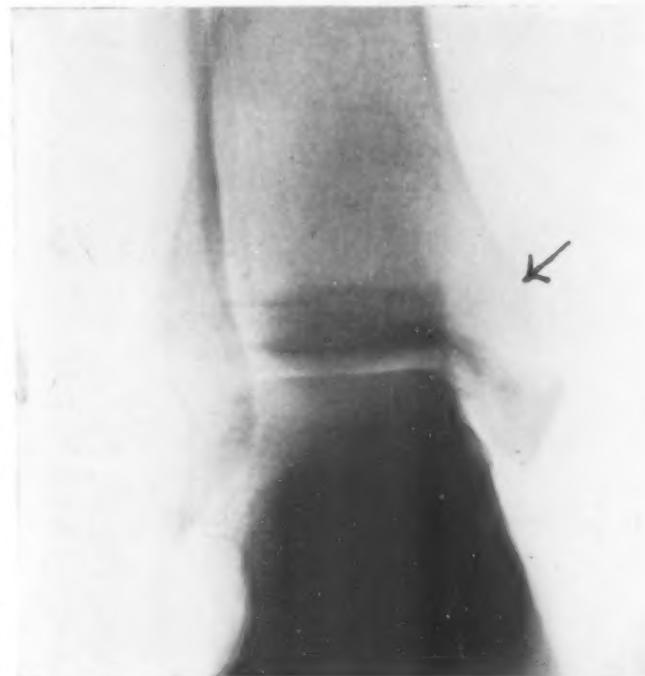


FIG. 4.—February 1, 1924. Anteroposterior view showing union in perfect position and no evidence of callus.

been conducting for upward of thirty million years. Wild animals and birds sustain fractures; the survivors, be they few or many, recover often with excellent function. They are able to move rapidly, to fight and to mate. Wild animals in captivity also sustain fractures, but seldom escape man's interference. The results are usually poor. Left to their own devices animals remain inactive for a time and then gradually increase their general activities and the stresses placed upon the broken bone. The results are usually good. Domestic animals are less fortunate. They are either promptly killed to terminate suffering that supposedly can eventuate only in crippling deformities or they are subjected to the indignities of plaster casts which they immediately attempt to remove. The results are usually bad and are attributed to the impossibilities of maintaining immobilization. If allowed to be guided by instinct, domestic animals follow the procedures of the unmolested wild folk in captivity.

Apparently relaxation of muscles follows the spasm produced by the painful irritations of injury. Traction furnished by dragging, gravity and the pull of opposed muscles suffices to provide adequate spontaneous reapposition. Moderate activity reinforced with the warmth supplied by licking prevents hypoxemia. Continued activity hastens the formation and solidifications of callus.

The results from the natural methods of treating fractures are not all good, and when poor they are usually atrocious. Much the same may be said

of the outcome when fractures are treated by men. Presumably there are combinations of artificial and natural procedures that can be employed so as to minimize the shortcomings of both.

The brilliant clinical and experimental investigations of Allison and Brooks<sup>1</sup> have furnished the information needed for an understanding of the practical significance of active motion and its relationship to resistance, defense,

FIG. 5.—January 23, 1924. Shows the extensive fragmentation and alignment obtained after use of calipers.

growth and repair of bones. They proved that non-use, however it may be caused, leads to atrophy of bone, which can be recognized radiographically within a few days after immobilization, and is progressive. Atrophic bone bends and breaks under less stress than normal bone according as it is more pliable or fragile and as the relatively excessive forces are applied gradually or abruptly. Atrophic bone differs physiologically from normal bone in retarded growth, in premature epiphyseal ossification and in reduced powers of resistance, defense and repair. Atrophy is produced by removal of normal stresses and strains of activity and by the hypoxemia inevitable with inhibition of function. Lesser degrees of atrophy are corrected promptly by restoration of function, which is active motion. Greater degrees of atrophy are corrected more gradually provided the stresses are not intolerable to the amount of bone present and are not applied abruptly enough to cause fracture

<sup>1</sup> *Surg., Gynec. and Obst.*, 1921, vol. xxxiii, p. 250; *Arch. Surg.*, 1922, vol. v, p. 499.

## ACTIVE MOTION IN TREATMENT OF FRACTURES

or so constantly as to cause deformities by exaggerating the normal curves of bones. Extreme degrees of atrophy, osteoporosis, prevent restitution of normal bone architecture.

Two features can be noted radiographically as bone atrophy develops and disappears. The total amount of bone visible in the intensities of shadows varies with the extent and duration of non-use and of re-use. There are even greater fluctuations in the denser cortical portions and more particularly in the lamellated structures which normally are more accentuated along the lines of stress. Absence or faintness of these lines which show stress-bearing capacities indicates incompetence to withstand normal function. Conversely, the reappearance of these lines in the radiograms is commensurate with returning competence.

Formations of callus are comparable to healing processes noted in the repair of soft tissues. Callus, like granulation tissue, is developed to bridge gaps and to provide fixation, and the total production exceeds actual demands. Both are responses commensurate with the intensity and duration of irritations. When bone healing is of a primary type the callus may be well nigh undemonstrable radiographically. As bone repair departs from the primary type because of malpositions, repeated hemorrhages, infections and the presence of foreign bodies, including sequestra, the callus productions increase in amount and become progressively less physiologic and correspondingly more pathologic. Thus there arise formations of callus that simulate exuberant growths of granulation tissue and those more comparable to keloids. The former is more and the latter is less amenable to the influences leading to involution of callus.

Callus is comparable to atrophic bone in that there is less than normal amount of bone within its periphery. Stresses imposed upon callus produce, as in atrophic bone, the development along appropriate lines of intensified or more compact structures. As activities are induced and continued these more



FIG. 6.—February 13, 1924. Shows application of plaster cast so that patient could have unrestricted movement of knee-joint; also shows position of fragments at this time and absence of atrophy one month later.

compact structures increase and bear the larger proportion of burdens. The remaining callus, less and less exercised, undergoes the atrophy of non-use. It is, therefore, clear why prolonged and excessive irritations increase the amounts of callus formed, and why excess callus, being rather pathologic than physiologic, responds less readily to the influences leading to involution. More important still from a practical standpoint is the knowledge that the earliest development of accentuated structure, attainable solely by active motion, limits to an irreducible minimum the total amount of callus formed.

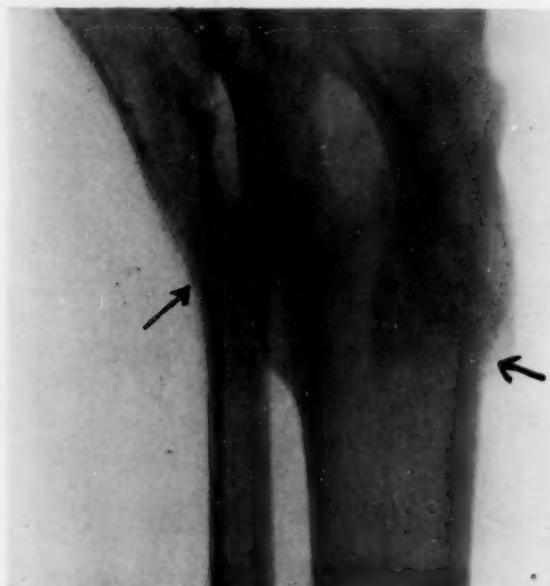


FIG. 7.—May 26, 1925. Repair eighteen months after injury provides perfect function despite anatomic abnormalities and atypical lines of stress. No excess callus was present at any time.

in structures along lines of stress is more trustworthy evidence of the degree of maturity of the callus and its capacity to withstand stress.

Joints add a serious complication to fractures. Some fractures are always associated with hemarthrosis; most fractures may be associated with hemarthrosis; and all fractures can be associated with traumatic arthritis. Acute traumatic arthritis, if immobilized, produces intra-articular fibrinous adhesions (Delrez) which precede fibrous adhesions. Fibrous adhesions are precursors of bony ankylosis (Hoffa). The one certain means to prevent organized intra-articular adhesions is suitable active motion (Willems). Immobilization of extremities produces atrophies and rigidities of normal joints which are corrected by resumption of motion, most certainly by active motion. All evidence thus far presented is but a confirmation of a homely philosophy—uninterrupted functions never cease.

The most troublesome and important complication of fractures, and the one too frequently given the least consideration, is the patient. Immobilization of an extremity causes atrophies and rigidities not restricted

On the other hand, immature callus, like atrophic bone, breaks and bends under less stress than normal bone. Resumption of activities has to be tempered with reason. Callus is competent only when those portions of its architecture are sufficiently developed to bear full burdens, and in consequence the burdens imposed must be restricted to the limitations in competence. The amount and distribution of callus may fail to indicate competence. The presence of increased density demonstrable radiographically

## ACTIVE MOTION IN TREATMENT OF FRACTURES

to bones and joints. Similarly, the immobilization of an individual causes the atrophies and rigidities not limited to skeletal structures. As already noted, a neglected fracture

can heal with an excellent recovery of function if all attention is centred upon keeping the patient alive. Perfect reapposition and fixation of fragments and the most comprehensive system that guarantees complete immobilization, obtained and maintained with ceaseless attention of the highest order, are somewhat futile if the patient perish

or become demented. Wherefore, there is wisdom in so regulating treatment that each individual be kept at the uppermost level of physiologic competence

which assures the highest general and local powers of resistance, defense, growth and repair as well as the largest opportunities for compensations and adaptations. Moreover, this scheme can still be advocated if, after healing is complete, functional recovery surpasses the cosmetic result.

**S U M M A R Y.**— Consideration of the more essential local and general actions

Fig. 8.—January 27, 1924. Impacted fracture of neck of left femur.

Fracture line indicated by arrows.

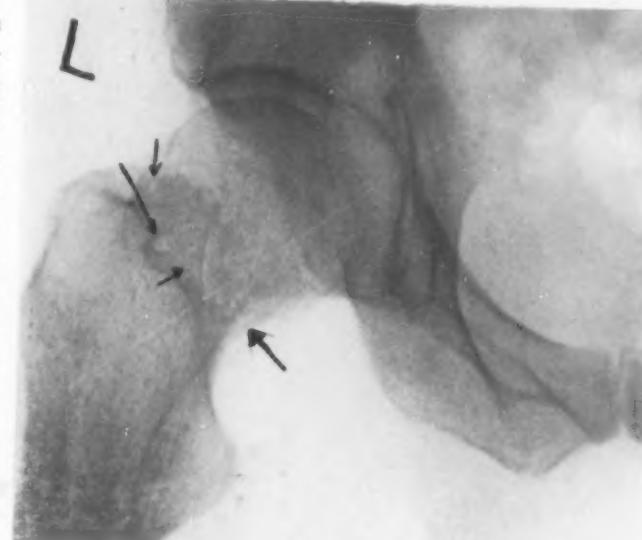


Fig. 9.—March 3, 1924. Shows state of healing after five weeks. Atrophy is not demonstrable; no callus is to be seen; lines of stress are reforming.

and reactions associated with fractures and their treatments by natural and surgical methods indicates the nature of procedures compatible with

therapeutic requirements which will more nearly satisfy economic demands. These are to protect each function against avoidable inhibitions and to secure

undelayed rehabilitation of every function. The means are to limit anatomic changes and to favor the reparative processes leading to restorations of the remote and local tissues more important to the patient. Normal structure assures normal function. The most important functions provide individuals with living competence. Dancers and pianists, for example, would be more likely to differ

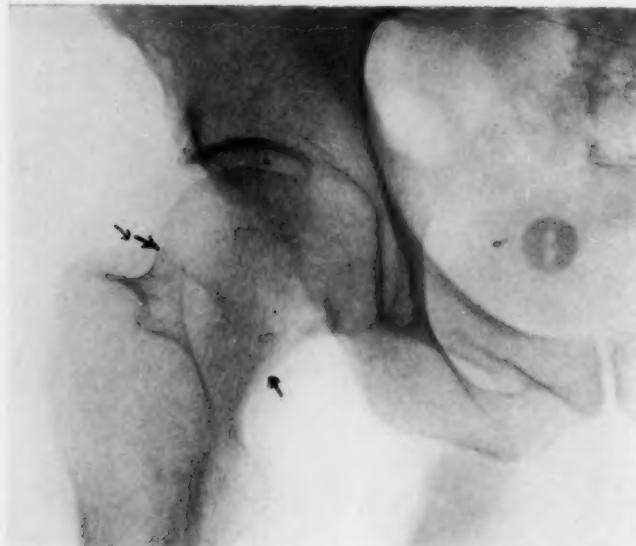


FIG. 10.—May 5, 1924. Complete restoration of weight-bearing lines in head and neck of femur, across line of fracture, and in ilium across the joint. No recognizable callus.

in their evaluations of integrities of hands and feet than of brains and hearts.

The following therapeutic details are noteworthy:

1. Treat the patient suffering from a fracture and not the fracture complicated by a patient.

2. Adopt such procedures as will interfere the least with general and local activities and which will permit the earliest resumption of unrestricted activities.

3. Reapposition of fragments.

(a) Attempt to secure with the least traumatism the reapposition essential to functional recovery.



FIG. 11.—December 1, 1924. Fractures indicated by arrows. Fragments could be seen with fluoroscope to move slightly with weight-bearing.

## ACTIVE MOTION IN TREATMENT OF FRACTURES

(b) If impaction is present and position of fragments is compatible with recovery of function, do not meddle.

(c) If spontaneous reapposition has occurred and the fragments are in satisfactory position, do not meddle.

(d) If reapposition is useless or impossible, do not meddle.

(e) If fracture is incomplete and alignment protects against subsequent deformity, do not meddle.

(f) Manipulations to obtain reapposition are least harmful when conducted under visual control furnished by fluoroscopy.

(g) Fair apposition obtained immediately by closed manipulations or presently by traction is usually preferable to more exact open reapposition.

(h) If open methods must be employed, the earlier the better, other conditions duly considered.

### 4. Fixation of fragments.

(a) The less fixation and support employed beyond the requirements for safety, the more perfect the repair.

(b) Many impacted fragments and some well-apposed non-impacted fragments require no fix-

ation, and, exceptionally, may require no support.

(c) Fragments that can be neither reapposed nor fixed need only tem-



FIG. 12.—February 5, 1925. Extent of repair attained after nine weeks of active motion. Fragments are better apposed; atrophy was obviated; and excess callus formation was avoided.

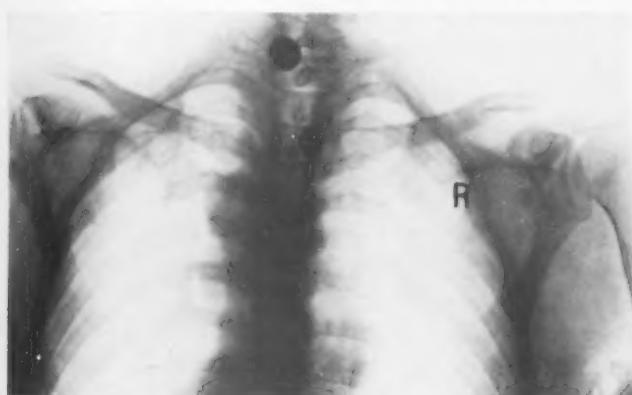


FIG. 13.—October 20, 1924. Fracture of right clavicle had occurred sixty-two years previously. Plate illustrates healing obtained when treated with active motion alone.

porary support to restrict pain and to avoid further injury while active motion is being instituted.

(d) Fragments that can be reapposed but not fixed by external means may require internal fixation.

(e) Internal fixation causing the least irritation is preferable; artificial impaction; iso-bone grafts or foreign bodies are available means.

(f) Absorbable foreign bodies are not invariably preferable to the less irritating non-absorbable foreign bodies or to those physically more dependable.

(g) Usually the more dangerous foreign bodies should be removed soon after they cease to be effective in providing fixation.

(h) Nails, pegs and screws loosen as contiguous bone atrophies, which occurs sooner if motion is prevented and the entire bone becomes atrophic.

#### 5. Immobilization.

(a) When safety permits, immobilization should be avoided.

FIG. 14.—January 11, 1924. Impacted fracture of neck of right humerus.

(b) Unavoidable immobilization should be interrupted at early intervals partly by passive and partly by increasing active motions.

(c) Plaster casts are undesirable unless they permit of earlier active motion than other apparatus since they exclude the beneficence of sunlight.

(d) Calipers, splints and frames can often be employed with less discomfort and so as to allow earlier active motion, particularly of joints.

6. Collateral measures. Diet, massage, manipulations, heat, light, placing patients in the open air, blood transfusions, physiotherapy—indeed, everything that will hasten repair and satisfy exactions of patients and friends is desirable.

CLINICAL OBSERVATIONS.—Notes and comments on a small series of patients treated for various fractures will illustrate possible achievements



## ACTIVE MOTION IN TREATMENT OF FRACTURES

when the methods employed coöperate with natural processes of repair. Mistakes have been made. Dangers will be mentioned.

I.—Laborer, aged forty-seven years. Crushing of foot, June 12, 1924. Fractures of second, third, fourth and fifth metatarsal and fragmentation and crushing of second and third cuneiform bones (Fig. 1). Slight laceration of soft parts. Foot much swollen, densely œdematosus. Hot wet dressings applied and extremity kept elevated for a few days. Then a snug flannel bandage employed and active motion begun, walking with aid of crutches. Patient's coöperation limited but capacity for moonshine unlimited. Materially improved though progress delayed by failure to walk properly. Condition four months later, October 10, 1924, shown in Fig. 2 and Fig. 2a. Has been working for five months as usual. Some deformity present. Disability slight, not interfering with active motion. Discharged by company, January 29, 1925, because of drunkenness. Disability rated at zero.

*Comment.*—Reaposition and fixation of these fragments was impossible. Active motion was employed early to secure the least undesirable reposition of fragments and to assure fixation and healing in those positions. Absence of atrophy in Fig. 2 and Fig. 2a is noteworthy as fixation of feet in casts, if immobilization is protracted, leads to extreme atrophy, the osteoporosis often being mistaken for inflammatory bone destructions. This is a common point of dispute in settlement of claims for permanent disability compensations. Fractures of this type, including many fractures of the os calcis, heal unsatisfactorily and lead to prolonged, often permanent, disability when treated with casts and non-use. Patients who will try to walk naturally, *i.e.*, without limping, if only for a few steps at a time, achieve the more complete and undelayed recoveries of function. Occasionally bicycle riding is an excellent means for getting suitable exercise. The greatest dangers of active motion therapy are that the patient's courage and persistence will be unequal to the tasks, or his confidence will be destroyed by friendly advice and legal counsel. Failure to regain function under these conditions will be attributed to the treatment advised and not to the lack of coöperation. Corporations are liable to be unjustly taxed for industrial compensation unless the State Commission is aware of the real causes. The Wisconsin Commission has been fair to both sides in these controversies.

II.—Nurse, aged thirty-three years. Fell, fracturing right internal malleolus, August 24, 1922 (Fig. 3). Adhesive plaster corset applied to foot, ankle and leg. Continued rather strenuous duties of caring for active children. Pain lasted for a few days. Recovery perfect. Nature of ultimate healing shown in Fig. 4, February 1, 1924.



FIG. 15.—October 17, 1924. Healing obtained in nine months, treated only with active motion. Function excellent. No atrophy. No excess callus.

*Comment.*—This patient was advised by other surgeons not to accept treatment that assured non-union and permanent disability. Such attitudes are the rule and indicate the risks of departing from convention. They illustrate nicely the type of testimony certain to be presented if a dissatisfied patient seeks legal redress. Protection can be secured in advance by making the patient or those responsible choose between natural and orthodox procedures after facts have been presented. If patients are incapable of obedience, it is wise to refrain from attempting the impossible.

III.—Secretary, aged forty-three years. Struck and dragged nearly a block by an automobile, January 17, 1924, sustaining comminuted fractures of upper right tibia and fibula, hemarthrosis of knee, cerebral concussion, shock and traumatic pleuritis.

Figure 5 shows positions of fragments after traction secured with calipers applied to malleoli. Hot dressing to knee, which was not aspirated. Early passive motion to knee. Plaster cast applied to leg as soon as fragments had become partly fixed, February 13, 1924 (Fig. 6). Active motion with slight weight-bearing begun and gradually

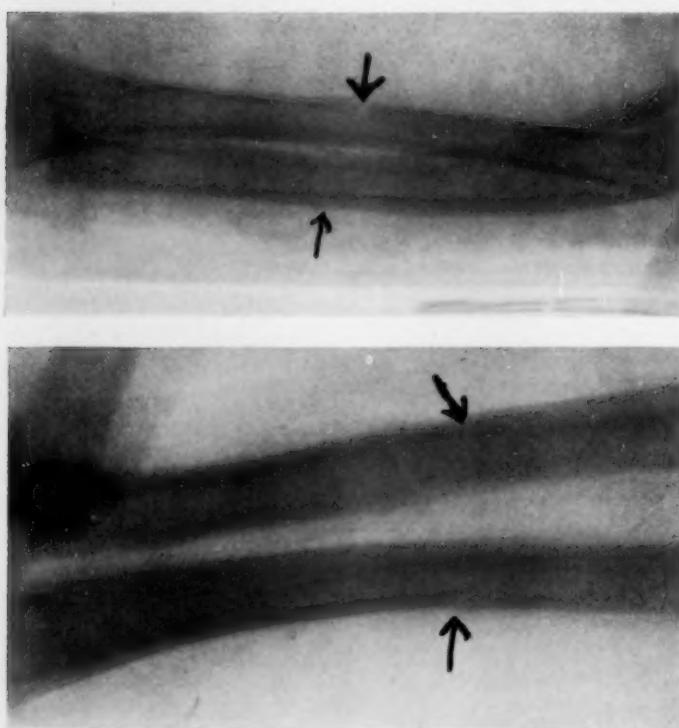


FIG. 16.—April 20, 1925. Anteroposterior and lateral views of forearm showing position of fragments after over-correction.

increased. Recovery complete in five months. Walks to and from office, sixty blocks each day. Her left leg is more easily fatigued. No real disability. Figure 7, May 26, 1925, shows nature of healing eighteen months after injury that has permitted complete recovery of function along atypical lines of stress. Functionless bone has disappeared through atrophy of non-use leaving a rounded outline. At no time was there formation of excess callus.

*Comment.*—This woman had courage, faith and persistence. Her healing shows that failure to obtain accurate repositions of fragments was of little moment. Increased densities show the abnormalities in lines of weight-bearing stresses. Atrophy of non-use has reduced certain projections. Active motion prevented excess callus formation and rigidity of her knee-joint. Her total distress was great but less in degree and in duration than had immobilization been prolonged. The progress she made was satisfactory but would have been more rapid had not timidity resulted from the accident. Shyness of motor vehicles persists as the only remaining complication.

IV.—Business man, aged forty-eight years. Fell January 26, 1924, sustaining an impacted lateral fracture of neck of left femur (Fig. 8). Was able to walk imme-

## ACTIVE MOTION IN TREATMENT OF FRACTURES

diately. Diagnosis established by inspection and radiogram. No manipulation. Was less comfortable if leg was supported with sand bags when prone. No traction employed. Active motion not interrupted. Patient had to be restrained from overactivity so that callus could mature without danger of giving away gradually or suddenly. Back at his desk in ten days. Used two crutches on the street, one crutch and then only a cane when indoors. State of healing in five weeks shown in Fig. 9, March 3, 1924. Intensifications along new line of weight-bearing stresses can be seen to have crossed lines of fracture and even across hip-joint. No atrophy is present. Absence of callus is striking in this radiogram. There never was any joint stiffness attributable to hemarthrosis. Started on an arduous business trip March 5, 1924, of three weeks' duration. Returned home before orthodox methods would have permitted weight-bearing. Condition ninety-eight days after injury showed in Fig. 10, May 5, 1924, wherein the stress-bearing lines in femur and ilium are clear. At present he is able to walk with but slightly increased fatigue, to climb stairs without restrictions, and to run without evidence of handicap. His limp and eversion of foot are barely perceptible.

*Comment.*—Deformities caused by impacted fractures of necks of femurs are so seldom remediable by external force that it is questionable if such procedures should be attempted, particularly in older patients. All solidly impacted and most partially impacted fractures can be treated from the beginning with active motion adapted to meet individual requirements. Some require support, particularly at night; others are better off with none.

Too much weight-bearing is dangerous because impaction can give way suddenly, when pseudo-arthroses are likely to develop, or gradually with resulting deformity and much increased disability. Impacted fractures are so much less painful than the unimpacted and the results attainable when impacted fractures are treated with active motion are so superior that two plans for treating unimpacted fractures suggest themselves: either to maintain reposition with some means that will permit motion, hasten repair and allow active motion to be resumed earlier than has been possible heretofore, or to create impaction and begin active motion forthwith. Traction inversion and abduction can be provided with weights, pulleys and a frame so that reposition and support can



FIG. 17.—May 9, 1925. Shows progress of healing and of callus formation in nineteen days; also fracture of other radius.

be given and yet allow a considerable range of activities to the bedridden. Similar traction, rotation and abduction can be transferred to splints and allow walking on crutches with some active motion though not weight-bearing. Repeated radiotherapy and radioscopy will determine whether repositions and fixations are compatible with good functional recovery. Or under spinal anaesthesia to provide relaxation without deep narcosis, the fragments can be reapposed with the aid of fluoroscopy and then fixed by driving a heavy spike through great trochanter, neck and into the head. Most of the pain is relieved, active motions can begin at once and, by preventing excessive bone

atrophy, permit natural fixation to develop effectively before the spike becomes loose and should be withdrawn. Our experience is as yet too limited to allow positive statements. Apparently both plans are feasible and practicable enough to be worthy of attention to develop their usefulness.

V.—Grandmother, aged sixty-four years. Injured December 1, 1924, in an automobile collision fracturing horizontal and descending rami, left pubic bone. (Fig. 11.) Her family was told the nature of her lesions. She was per-



FIG. 18.—Formation of callus limited. Early restitution of stress-bearing structures. Prompt and complete recovery of function.

suaded that minor lacerations healed best when treated with contempt. A snug adhesive plaster corset was applied. She kept about her housework and went up and down stairs with little assistance. Her recovery was quite complete in three weeks, Fig. 12, February 5, 1925, shows the bone healing obtained. Now aware of the more serious nature of her injury, this maiden is quite proud of her achievement and courage. Had she known of the fracture at first she might well have been too timid to keep moving.

*Comment.*—Bilateral fractures of the pelvis and those complicated by visceral lesions (e.g., perforations of the bladder) require suitable periods of inactivity but far less than is supposed to be necessary. Patients with such fractures need support, but should be encouraged to keep moving their legs and to shift their positions as early and as often as pain permits. Getting into wheel chairs and trying each day to indulge in more self-help provides profitable diversions that hasten recoveries.

Fractures of ribs, sterna, vertebræ, scapulae and jaws can be treated with active motion and excellent results obtained. Lack of satisfactory radiographic evidence of the positions of fragments before and after healing that would illustrate repair prevents presentation of specific examples.

VI.—Physician, aged seventy-two years. Fell from a tree when ten years of age and fractured right clavicle. He had been coveting his neighbor's fruit and omitted mention of his mishap. Maternal watchfulness detected reduced exuberance. The family

## ACTIVE MOTION IN TREATMENT OF FRACTURES

physician recognized the cause. He did not meddle. The present condition, Fig. 13, October 29, 1924, is evidence of his wisdom.

*Comment.*—Most fractures of the clavicle treated by motions designed to produce reapposition or only by neglect will heal perfectly. Some overlapping and deformity therefrom and from callus may result. Interference with function is unknown. Delrez proved in his treatment of soldiers with fractured clavicles that active motion resulted in the least duration and extent of disabilities. Girls and athletes are the exceptions that require intervention if overlapping of fragments threatens. Application of the crucifix splint is said to be comforting; the name is not.

VII.—Grandmother, aged eighty-one years. A fall down stairs, January 11, 1924, caused an impacted fracture of the neck of her right humerus (Fig. 14). She was bullied into trying to take care of herself from the first. She escaped a permanently stiff and painful shoulder and regained a competent arm in a few months. Figure 15, October 17, 1924, shows the improvements obtainable through activities by older people.

*Comment.*—Injuries near the shoulder-joint, either in humerus or scapula, are prone to terminate in obstinate stiffness and persistent pain if immobilization is permitted. The earlier activities are resumed after injury, the more conscientiously they are continued and increased, the more prompt and complete are recoveries.

VIII.—Boy, aged twenty months. Fell April 18, 1925, achieving green-stick fracture of both radius and ulna, which was not recognized until April 20, 1925 (Fig. 16). Deformity was overcorrected and a splint applied to the extensor aspect of the forearm that permitted constant use which was encouraged. Fell again May 9, 1925, breaking the other radius (Fig. 17), which received no treatment save reflex restriction of motion from pain inhibitions. Results showed on Fig. 18, May 20, 1925. Limited callus formation, early restitution of intensities along stress-bearing lines, absence of atrophy, and complete rehabilitations of functions which were never interrupted show that the methods were not harmful.

*Comment.*—This youngster's experience illustrates the necessity of supplementing

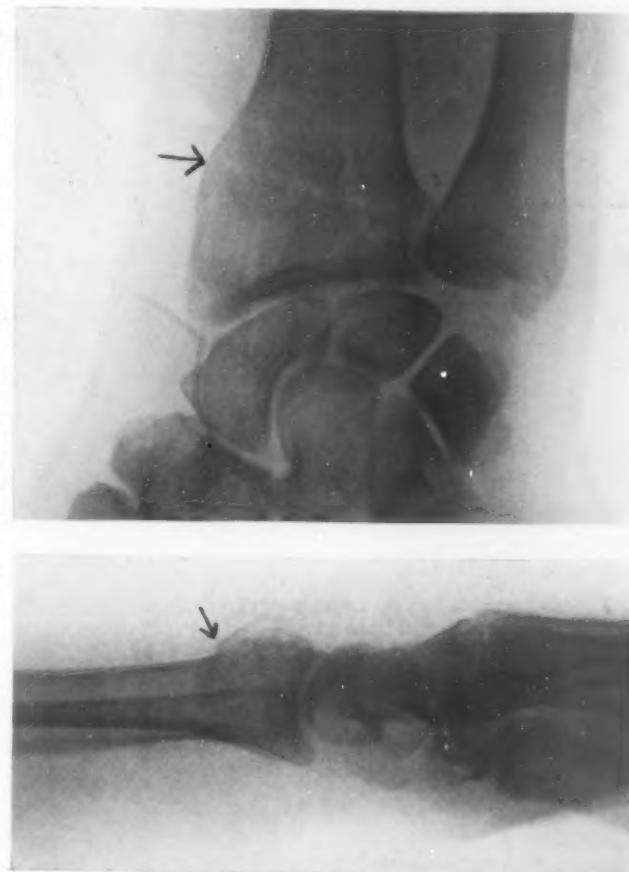


FIG. 19.—January 17, 1925. Line of fracture and slight impaction both evident.

natural methods to obtain the structural recoveries needed for normal function and the wisdom of interfering as little as possible with those methods.

IX.—Housewife, aged twenty-two years. Fell January 17, 1925, and achieved a Colles' fracture (Fig. 19). Well apposed fragments were probably impacted. Used a sling to support the forearm. Hand dependent, enforcing flexion and adduction of wrist. Knitted a great deal. Prompt recovery without deformity or disability. A skiagram, February 2, 1925, showed the bone-healing to be reliably strong. Radiogram, Fig. 20, taken May 25, 1925, proves that the slight degree of early atrophy had disappeared and shows the final repair. Function perfect.



FIG. 20.—May 25, 1925. Healing obtained in four months with active motion. Despite disappearance of normal curve of radius, functional recovery was perfect.

were underestimated. Too much confidence was placed in the amount of callus and too little attention paid to the lack of accentuation of bone structure along the lines of stress.

**CONCLUSIONS.**—Reasons have been given to show why bone repair occurs more promptly and advantageously, if active motions are employed. Evidence has been presented to prove that coöperation with the natural reparative processes leads to earlier healing and more complete functional recoveries than are obtainable by the orthodox procedures wherein immobilization is enforced.

Progress made in treatment is commensurate not only with reductions in mortality rates, but also with restrictions in durations of immediate and in extent of ultimate disabilities. Advances are noticeable when therapeutic procedures coöperate with natural processes which include resistance, defense, growth and repair.

Treatment of fractures, so as to coöperate with Nature's methods of healing is the one way to obtain better results.

Active motion is a constant factor in recovery and no recovery is complete until unrestricted active motion is possible.

The earlier active motion is instituted the more prompt and complete are recoveries, provided a development of deformities is prevented during the healing process.

Methods of treating fractures should be designed to interfere the least with general activities and to permit the earliest resumption of active motion by the structures involved in the injury.

## TRAUMATIC LUXATION OF THE HEAD OF THE FIBULA\*

BY HENRY H. M. LYLE, M.D.

OF NEW YORK, N.Y.

ISOLATED dislocations of the superior tibio-fibular joint are often observed as the result of disturbances in growth, after acute osteomyelitis and in complicated fractures of the upper end of the tibia and fibula. Occasionally it occurs as a complication in amputation stumps. Simple traumatic dislocations of the head of the fibula are, on the other hand, extremely rare. We have collected forty-one cases,† thirty-nine from the literature and two from our practice. We do not believe that these figures represent the true frequency as many cases are undoubtedly unrecognized and others being of minor import are not reported.

The dislocation occurs most frequently in young adult males. The youngest recorded case is an infant of eighteen months, the oldest a man of fifty-two. The displacement may be forward, backward or upward. It is caused by muscular action or direct violence.

*Forward Dislocation.*—As the head of the fibula is situated behind the most external part of the tibia a dislocation forward must also be outward. We have collected twenty cases of forward displacement. The number includes Vaccari's unique case of double dislocation. While the majority are caused by a fall with the leg bent under the body, a few result from muscular action without a fall. Stimson believes that the forcible depression and inversion of the front of the foot may be a factor in the production and cites Savournin's and two of his own cases in evidence. Hirschberg's and Emmert's cases come under this head. Klose's patient, in attempting to spring up from a kneeling position, displaced the head of the fibula forward; the dislocation probably resulted from an overcontraction of the extensor muscles arising from the side of the fibula, the head being drawn forward by their forcible contraction. This is the reverse of the posterior dislocations, here the displacement is brought about by the violent contraction of the biceps. Tillaux does not believe in the theory of muscular contraction. He concludes from experiments on the cadaver that when the tibio-fibular ligaments, as well as the malleolus, remain intact, the result is either a fracture of the fibula or a luxation of its upper end. He cites a transverse fracture of the tibia above the tibio-fibular ligament which was accompanied by a simultaneous luxation of the head of the fibula. Spiral torsion fractures of the tibia are quite frequently accompanied by a higher complimentary fracture of the fibula. If the fibula remains intact and the force continues, we believe that in a few cases the head of the fibula is dislocated or the joint capsule severely strained.

\* Read before the American Surgical Association, May 6, 1925.

† This figure does not include Cooper's and Shaw's traumatic cases, Fenwick's congenital, Bryant's pathological or Lyle's amputation stump cases.

HENRY H. M. LYLE

Lately it has been our practice to make a careful examination of this joint in all fractures of the tibia and we have been surprised by the number of cases in which this joint has evidently been damaged.

*Backward Dislocation.*—We have collected twelve cases of this displacement. A few cases are caused by the forcible contracture of the biceps, others by direct external violence, while the majority follow a fall. In these cases the following mechanism probably occurs, the leg is twisted, the superior tibio-fibular ligaments rupture and the loosened head of the fibula is drawn backward by the biceps. In the posterior dislocations the leg is held in a flexed position.

*Upward or Total Dislocation.*—This displacement is caused by an upward thrust of the fibula and is associated with trauma to the ankle. From a practical standpoint it is a dislocation upward of the whole bone. Four cases are reported: Boyer's, Stoll's, Sorbet's and Stromeyer's. Boyer's case was associated with an outward dislocation of the ankle in which the fibula, instead of breaking, was forced bodily upward. Stoll's patient, a circus rider, leaped from his horse and alighted on his toes. Stimson believes that Sorbet's case is too incomplete to be included. In Stromeyer's case the force acting from below on the outer edge of the foot forced the fibula upward.

*Double Dislocations.*—There are five cases, four of these are upward displacements and the fifth is Vaccari's case, in which the head of the fibula was displaced forward and the malleolus backward. The patient, a man aged fifty-two, while intoxicated, fell with his leg flexed under his thigh, the foot being in forced flexion and abduction.

*Symptoms.*—The acute cases complain of severe pain and tenderness over the joint the chronic cases experience a feeling of weakness. Although the patient may not be able to walk on account of the pain, active movements at the knee are possible. A sharp pain high up on the fibula produced by evertting the foot is considered by Cotton to be a pathognomonic sign. In the double dislocations there is in addition pain, tenderness and swelling of the ankle. Motor and sensory symptoms referred to the external popliteal nerve are present in a few cases and vary from slight sensory disturbances to paralysis and permanent drop-foot. In the anterior displacements the leg is extended and the foot adducted; in the posterior the leg is held in a semi-flexed position. The tenseness and direction of the biceps tendon varies with the dislocation. In the anterior dislocations the biceps stands out as a tense curved cord with concavity forward; in the posterior it is tense and vertical; in the upward displacement the tendon is relaxed.

The head of the fibula can be seen and felt to be displaced. The displacement is readily verified by comparing the measurements of the injured knee with those of the normal. For this purpose the distance from the tuberosity of the tibia to the styloid process of the fibula makes a convenient comparison.

Abnormal mobility at the superior tibio-fibular joint is present in 20 per cent. of the cases; slight mobility in 60 per cent. and is absent in 20 per cent. If the leg is extended it may have to be flexed before the mobility can be

## TRAUMATIC LUXATION OF THE HEAD OF THE FIBULA

detected. Bennet, of Dublin, has pointed out that occasionally the upper end of the fibula does not reach the facet on the tibia. This anatomical fact is to be kept in mind.

*Treatment.*—In the majority of the cases reduction is readily accomplished by direct pressure, the knee being flexed to neutralize the pull of the biceps. Spontaneous reduction occurred in three cases; in eleven cases replacement took place during the anaesthetic struggles. Forceful traction and manipulation of the foot is required for some of the double dislocations. In Boyer's case reduction of the outward dislocation of the foot automatically reduced the dislocation of the head of the fibula. Fixation is accomplished by suitable retentive dressings left in place for four to seven weeks. The retentive dressings vary from Cooper's encircling strap and buckle to the incasement of the leg and knee in plaster-of-Paris. Although reduction as a rule is easy, a few cases may require operative interference either to accomplish the reduction or to maintain it. This latter class includes the recurrent cases, old unrecognized displacements giving rise to disability and the acute cases in which the anatomical or pathological conditions preclude a fixation by conservative means. There are four recorded cases of operation, Stimson's, Cotton's and Lyle's. All four gave perfect end results. In Stimson's case reduction could not be accomplished until an arthrotomy had been performed. In Cotton's first case an erosion of the joint with temporary spiking was employed, in the second an erosion with fixation by a fascia lata suture. In the author's case a simple arthrodesis was performed. It is interesting to note that the cases requiring operative fixation were all posterior dislocations. The flat joint surface, combined with the strong posterior pull of the biceps, are undoubtedly factors in keeping up this dislocation.

*Prognosis.*—Conservative treatment gives excellent anatomical and functional results, occasionally a weakness develops when the biceps is brought into strong action. An accompanying recurrent local synovitis or an associated synovitis of the knee may give rise to considerable weakness and fatigue in walking. In two cases the lesion was complicated by paralytic drop-foot. In Oldbright's and B. Cooper's cases of neglected backward displacement, the dislocation was readily reduced, but could not be maintained. Although only a slight weakness developed in Erickson's case, a permanent backward displacement, the patient was unable to jump.

The complications arising in the backward displacement, *i.e.*, the difficulty of retention after reduction, and the paralysis resulting from damage to the external popliteal nerve, show the posterior dislocation to be a more serious lesion than the anterior.

**CONCLUSIONS:**

1. Simple traumatic dislocations of the superior tibiofibular joints are rare.
2. The forward dislocation is the most frequent; the posterior the most serious.
3. Reduction and immobilization are readily accomplished.
4. A few cases require operative interference.

## HENRY H. M. LYLE

### CASE REPORTS

**CASE I.**—*Posterior dislocation of the superior tibio-fibular joint of eighteen months' standing. Arthrodesis—cure.* The patient, a healthy male, aged twenty-two, was referred to Doctor Lyle's service at St. Luke's Hospital by Dr. A. H. Dugdale, the diagnosis being posterior dislocation of the head of the fibula. Eighteen months previously his left knee was caught between a moving planing bench and a heavy barrel. He experienced considerable pain on the outside of the knee and although he could move his knee, the pain prevented him from walking. He was conscious of a movable bone on the outer side of his knee. The condition was diagnosed as a posterior dislocation of the head of the fibula and confirmed by X-ray examination. The dislocation was reduced and the leg immobilized in plaster. Each time the plaster was removed the dislocation recurred. On July 9, 1924, he entered the hospital for an arthrodesis. His chief complaint being pain and weakness of the knee. Examination shows a typical posterior dislocation of the head of the fibula, there is a moderate range of mobility which is accompanied by pain. A mild degree of synovitis is present. X-ray examination shows a moderate degree of separation of the upper ends of the tibia and fibula. Operation July 11, 1924. Arthrodesis of the upper left tibio-fibular articulation.

**Pathological Findings.**—The ligaments binding the head of the fibula to the tibia were ruptured, allowing a free motion of the fibula on the tibia. Operative procedure: Cartilage removed from both joint surfaces, the surfaces were approximated and capsule sutured with the leg flexed at the knee and a plaster case applied. The patient made an uneventful convalescence, the case being removed at the end of six weeks. Examination ten months after the operation shows a firm fibrous ankylosis.

**CASE II.**—*Posterior dislocation of the head of the fibula complicated by a paralytic drop-foot.* Six months previously the patient, a boy aged sixteen years, while playing football, was kicked on the outside of the knee; he felt something snap and fell to the ground. Although he could move his knee, he could not stand or walk on account of the pain. A diagnosis of dislocation of the head of the fibula was made by his doctor and confirmed by X-ray examination. The dislocation was reduced by the school doctor and the leg immobilized in plaster. On removing the case, six weeks later, it was noticed that the patient had a drop-foot; this condition gradually improved until two months ago, since then it has remained stationary. He now comes for advice regarding the paralytic drop-foot.

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## THE EFFICIENCY AND INEFFICIENCY OF CERTAIN SKIN ANTISEPTICS\*

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THE problem of infection in the so-called "clean case" presents itself at intervals in every hospital. At such times, sponges, towels, sterilizers, etc., are investigated rigidly and little thought is ordinarily paid to the most frequent source of trouble, the method of preparing the skin of the patient. The antiseptic technic of the average hospital is considered by its staff as standardized, practically infallible, and is subject to little change. Estimates of the value of antiseptic methods are generally based on laboratory experience under conditions very unlike the clinical conditions which obtain in the operating room or hospital ward, and surgeons who carefully follow wound-healing almost invariably report occasional infections following clean operations. The efficiency of widely-used skin disinfection methods under certain conditions early impressed us during bacteriological laboratory tests used in teaching medical students the principles of surgery. These methods were outlined by Obendorf, *American Medicine*, 1906, vol. xi, p. 405, further emphasized in a later paper (*Journal of the American Medical Association*, 1910, vol. lv, pp. 1430-34), and the fallacies of the then popular iodin methods were specially studied (*Surgery, Gynecology and Obstetrics*, June, 1911, p. 530). The selective action of certain antiseptics for certain bacteria was recognized in these earlier studies when plate cultures of anthrax were seen to leave a wide, clear zone around metallic silver while *B. pyocyanus* grew almost up to the silver. The importance of selective action was not then appreciated, but recent studies indicate its importance with a re-study of methods of skin disinfection. Several fundamental questions other than those pertaining to selective action of bacteria seem still relatively unsettled and of sufficient interest and importance to deserve further study. For the sake of clearness we have stated these as follows:

In what percentage of cases are bacteria present on or in the skin of protected areas of the body? Is the hernial area more frequently contaminated than the breast?

How efficient is the ordinary soap and water scrub in freeing the skin from bacteria?

How efficient is hospital ward preparation?

How efficient are various antiseptics in the presence of blood?

How important is the element of time? What is the efficiency of our various antiseptics with resistant bacteria if spores be given time to germinate?

\* Read before the American Surgical Association, May 6, 1925.

## EFFICIENCY OF SKIN ANTISEPTICS

What of the selective action of various antiseptics? Are some of the recently studied dyes more efficient in dealing with certain resistant bacteria than other hitherto more commonly-used agents?

In this study of these questions over 1200 laboratory tests were made; a group of Cornell Medical students and pupil nurses from Ithaca City Hospital donated the use of their skins; Doctor Goldberg, Pathologist, and Miss Masterson, Technician of the Ithaca City Hospital, contributed freely of their time; most important of all, the facilities of the bacteriological laboratory of Cornell University were put at our disposal by the Director, Dr. V. A. Moore, and his associates, who also gave us most valuable advice and help.

The methods used and results obtained were as follows:

*Skin of Protected Areas.*—Tests were made by Miss Masterson, Technician of the Laboratory. The skin of the inguinal and breast region of twenty pupil nurses was tested: no special preparation as to cleanliness or disinfection was made. The skin was moistened with sterile water and scrapings made down to the true skin with a scalpel which had been thoroughly flamed; scrapings were transferred by a platinum loop to agar slants and broth. Six of twenty-two cultures from the inguinal region and four of twenty-one cultures from the breast region were found free from growth. This is contrary to general teaching, that the deeper layers of the skin always contain bacteria, and that the inguinal region is more likely to be contaminated than the breast.

*The Efficiency of Soap and Water Scrub.*—Areas of two inches in diameter were smeared with broth cultures of the resistant spore-forming *B. Subtilis* and allowed to dry well. They were then scrubbed with gauze and soap and water for two minutes and scrapings were made and cultured as above. Thirty per cent. showed no growth.

These two groups of tests apparently show that the absence of bacteria in or on the skin generally attributed to the use of antiseptics may be from ordinary cleanliness or the use of the simplest mechanical and cleansing agents.

*Efficiency of Ward Skin Preparation.*—Preparation for routine hospital operations was made with soap and water scrub, followed by ether, 95 per cent. alcohol, and mercuric chloride solution 1:1000 and an additional swabbing with ether on the operating table. Skin scrapings were taken as detailed above and gave 75 per cent. no growth in fifty-eight instances. Although the number of growths were very few and the number of colonies did not exceed three in any case, the fact that the bacteria are occasionally present after hospital ward preparation indicated the importance of a further final preparation on the operating table.

In previous series of experiments to test the efficiency of various antiseptics in skin disinfection, the skin was smeared with bouillon cultures of non-pathogenic bacteria and the methods of disinfection were carried out precisely as they would be in the operating room or hospital ward. Recent observations on the selective action of certain antiseptics for certain groups of bacteria have made it seem necessary that each antiseptic which we pro-

MARTIN B. TINKER

pose to use be tried individually with all the bacteria which it might under any circumstances be necessary to kill. It would be obviously dangerous to use virulent, disease-producing bacteria on the skin of any one. Hence the following method was used, suggested by experiments made to test the value of rinsing the gloved hands in antiseptic solutions, as is commonly done in most operating rooms. Strips cut from discarded rubber gloves were dipped into each culture, allowed to dry, then dipped into the antiseptic solution which it was desired to test. It was found that with certain bacteria and certain solutions the rubber strips were uniformly free from contamination. In other cases, with other germs or with other antiseptics, the strips were frequently, or in some cases, uniformly contaminated. It is obvious that if bacteria are not killed on this smooth rubber surface with perfect contact, it would be unreasonable to expect them to be destroyed under conditions requiring penetration and imperfect contact.

*The Effect of the Presence of Blood on the Efficiency of Antiseptics.*—Blood was used in the culture media in studying streptococcus haemolyticus only and with blood present in the media was it found as difficult to kill as some of the supposedly very resistant spore-forming organisms. It would be interesting to test the effect of blood with cultures of other organisms, but time did not permit with this series of tests. With plain broth, streptococcus haemolyticus proved as easy to kill as staphylococcus albus, all antiseptics proving effective, while with blood in the media only the dyes and picric acid (See Table) were found efficient.

*Efficiency as Related to Preventing the Germination of Spores.*—Cultures of certain spore-formers were kept under observation in the incubator for five weeks without the appearance of any growth, so it seems fair to assume that spores are killed by some of the antiseptics. The special organisms and antiseptics are shown in the accompanying table.

*Selective Value of Antiseptics.*—The selective action of certain dyes was strikingly shown: some infallibly killed resistant spore-forming bacteria, while others failed to kill even the relatively non-resistant *B. coli communis*. (See Table.) Churchman has made several valuable contributions to this subject, during the past four years, calling attention, for example, to the fact that *B. pyocyaneus* is killed by acid fuchsin, one of the less efficient dyes, while this germ resists practically every ordinary antiseptic which we have tried, except five per cent. alcoholic acriflavine solution. Probably it is only by use of combinations of several antiseptics that efficient skin disinfection can be attained.

*Is One Hundred Per cent. Efficiency of Disinfection Possible?*—Thus far among many commonly-used antiseptics only chlorinated lime paste killed anthrax spores under clinical conditions and in the length of time which would be ordinarily practical in surgery. Anthrax spores are fortunately seldom present on the skin of patients. There can be no doubt that efficiency of skin disinfection could be greatly increased by careful ward and operating room preparation followed by the use of the combination of some of the more

## EFFICIENCY OF SKIN ANTISEPTICS

efficient antiseptics, probably especially the dyes. The present cost of the dyes is prohibitive, so far as use in the strength necessary for rapid effect and in the quantities ordinarily employed are concerned. However, it is possible by careful use with a small swab to make one-half ounce of 5 per cent, acriflavine solution cover the average skin area needing preparation. This

TABLE I.

	Subtilis	Staph. albus	Staph. aureus	B. coli	Strep. hem. blood broth culture	Strep. hem. broth culture	B. Pyocyanus	Anthrax vegetative	Anthrax spores	Tetanus	Welch
Alcoholic Iodine, 5%.....	■ 100	○ ○	○ ○	○ ○	■ 100	○ ○	■ 66	■ 33	■ 100	○ ○	○ ○
Benzine Iodine, 5%.....	■ 100	○ ○	○ ○	○ ○	■ 75	○ ○	■ 100	■ 33	■ 100	66 66	33 33
Picric Acid 5% in 95% alcohol	■ 100	○ ○	■ 50	○ ○	○ ○	○ ○	■ 66	■ 100	■ 100	○ ○	33 33
Harrington's Solution.....	■ 24	○ ○	○ ○	○ ○	■ 100	○ ○	■ 33	○ ○	■ 100	75 75	○ ○
Mercurochrome 5% in 50% alcohol	■ 90	○ ○	○ ○	○ ○	■ 75	○ ○	■ 66	○ ○	■ 100	66 66	33 33
Acriflavine 5% in 50% alcohol	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	■ 100	○ ○	○ ○
Acriviolet 1% aqueous.....	■ 50	○ ○	○ ○	■ 100	○ ○	○ ○	■ 100	○ ○	■ 100	○ ○	■ 100
Acriviolet 2% in 50% alcohol	○ ○	○ ○	○ ○	■ 25	○ ○	○ ○	■ 50	○ ○	■ 100	○ ○	■ 100
Figure.....	I	II'	III	IV	V	VI	VII	VIII	IX	X	XI

Table shows the effect of contact of antiseptic with bacteria for three minutes. If two or three antiseptics are used in order to get selective action this will consume as much of the fifteen to twenty minutes usually devoted to skin disinfection as is ordinarily available. The circles indicate no growth; black squares, growth, and figures underneath, percentage in which growth occurred.

one-half ounce of solution would represent the cost of several gallons of the ordinarily-used antiseptic solution. In many previous tests, Harrington's solution, double strength, has given very efficient results, much more so than in this series. It is possible that the bacteria used in this series have been more than ordinarily resistant.

Churchman's observations on communal activity of bacteria show that single organisms; motile, resistant strain of *B. coli* or small groups of this organism up to 30, do not grow in very dilute gentian violet broth, or on gentian violet slants, but do grow if larger numbers of bacteria are present. This suggests the possibility that similar conditions may obtain with other bacteria. In such case if the number of bacteria can be reduced to only

MARTIN B. TINKER

three, which was the maximum found after our ordinary ward skin preparation, it is possible, that the dyes would be efficient in low enough dilutions and consequent lower cost, to make their use available for the average hospital.

In estimating the efficiency of antiseptics for surgical use several considerations enter in beside the efficiency in killing bacteria: time of action, cost, simplicity in use, clearness in outlining the field of operation, damage to supplies and the patients' tissues.

Time is an important element in the operating room, not only as concerns the surgeon and his staff, but especially in dealing with very ill patients. The antiseptic under consideration should be efficient in the five to ten minutes' time ordinarily available in the operating room. Few operating rooms will devote much more time than that to skin preparation. The antiseptics shown were tested for periods of two to five minutes, three minutes being considered the standard, which was tabulated.

Cost must be considered in most hospitals. The antiseptic under investigation should be readily available in amounts necessary and at reasonable cost. Among the efficient antiseptics the dyes are at present prohibitive in cost. Chlorinated lime paste is not shown in the table, but has been found in previous tests as well as a limited number in the present series to be most efficient and is extremely low in cost, as is also Harrington's solution.

Clearness and accuracy in outlining the field being prepared has no doubt influenced the widespread use of picric acid and the iodine preparations. Apparently other more efficient antiseptics are available which outline the field equally well, and make certain that all is adequately covered. The dyes, especially acriflavine, have this advantage. Recently we have added a small amount of acid fuchsin to Harrington's solution in order to outline its application.

Simplicity of technic is very important. The antiseptic employed should give dependable results in the hands of relatively untrained pupil nurses and interns.

Damage to instruments and materials is also important: we have to consider the corrosive action of certain mercurial antiseptics on instruments and apparatus, and the holes frequently eaten in protective sheets, towels, and operating gowns by the chlorine antiseptics and Harrington's solution in estimating their usefulness.

Damage to the patients' tissues is a most important consideration. The antiseptic should not cause blistering or raw skin, intestinal adhesions, delayed wound-healing, or any other of a number of disadvantages of certain commonly-used antiseptics. Iodine has been discarded by many surgeons for these reasons alone. The dyes are found by some to delay wound-healing, but probably not when only used on the skin.

Clean wound-healing is the most important consideration. *Will the antiseptic kill all germs which might by any possibility be present, and under all conditions?* If not, is it possible to find a combination of antiseptics which

## EFFICIENCY OF SKIN ANTISEPTICS

will prove efficient? The table shows our results and to this should be added that we have found fresh chlorinated lime paste is always efficient.

### CONCLUSIONS

1. The superficial and deeper layers of the skin of protected areas in cleanly individuals are frequently free from bacteria.
2. If the skin be smeared with resistant non-pathogenic bacteria, soap and water scrub alone for two minutes will make it free from bacteria in 30 per cent. of cases.
3. Careful ward preparation with ether swab on the operating table is capable of giving skin free from bacteria in 75 per cent. of cases, and of reducing the colonies in the remainder to a maximum of three.
4. The selective action of antiseptics is so important that it seems wiser not to depend upon any single antiseptic for skin preparation.
5. Iodine preparations, picric acid, and alcohol alone which seem still to be the chief reliance in a number of hospitals, are too inefficient under ordinary clinical conditions to be depended upon for routine skin disinfection.
6. Acriflavine 5 per cent. proved most efficient in this series of tests, but probably its use combined with other dyes and antiseptics might be desirable. The chief drawback to the use of the dyes is their almost prohibitive cost.
7. It would probably be safer not to discard altogether the use of some of the older relatively efficient antiseptics until those used to supplant them have been given thorough clinical as well as laboratory tests in a number of hospitals.

TRANSACTIONS  
OF THE  
NEW YORK SURGICAL SOCIETY

*Stated Meeting Held March 11, 1925*

The President, DR. EUGENE H. POOL, in the Chair

GALL-BLADDER DISEASE IN EARLY LIFE

DR. EDWARD D. TRUESDELL presented a woman, who being twenty years of age, was admitted to St. Luke's, September 5, 1924. There was a five months' history of attacks of epigastric pain, nausea and vomiting. These symptoms were relieved by vomiting. There had been a period of two weeks of jaundice. She was brought to the hospital by a more severe attack of pain than usual, with a slight return of the jaundice. She had been married two years and had borne a child at term. *The physical examination* was negative but for slight localized tenderness over the gall-bladder. The jaundice complained of was not apparent. *At operation* the gall-bladder wall was found to be greatly thickened; the common-bile duct was dilated; the entire pancreas was greatly thickened and indurated. *Operation* consisted in the removal of the gall-bladder, with drainage of the common duct. As the common duct could not be entered through the cystic duct on exploration, the former was incised in its course through the gastro-hepatic omentum and a small soft rubber tube inserted. The recovery was entirely uneventful.

The patient is presented to show an advanced degree of gall-bladder disease, with dilation of the common bile duct and a chronic pancreatitis in a young woman in her twenty-first year.

In a series of 47 successive cholecystectomies for cholecystitis associated with cholelithiasis, including the present case, 11 were in patients giving their ages as 30 or under. Of these 11, 2 were 20; 2 were 23; 1 was 27; 2 were 29, and 4 were 30 years of age.

These facts offer further evidence in favor of the belief that gall-bladder disease not uncommonly has its inception in the latter part of the second decade of life.

DR. EDWARD W. PETERSON said that he had shown before the surgical section of the Academy, a boy eight years of age with acute cholecystitis, and had reported the case of a fifteen-year-old girl with an infected gall-bladder with a number of stones. Rolleston reports gall-stones in the newborn.

DR. HOWARD LILIENTHAL referred to a case which he had reported before this society a number of years ago. The patient was a girl of eleven upon whom he performed cholecystectomy, finding numerous pigment stones in the gall-bladder. Many years later she died of pernicious anæmia. Dr. A. A. Epstein suggested that blood abnormality may have had something to do with the throwing down of pigment in a possibly infected gall-bladder.

ACUTE TORSION OF THE FALLOPIAN TUBE

DR. EDWARD D. TRUESDELL presented a woman, age thirty-six, who was admitted to St. Luke's Hospital for the repair of a lacerated cervix and perineum. Pre-operative pelvic examination failed to reveal abnormalities

## ACTINOMYCOSIS TREATED BY IODIDE IONIZATION

other than the laceration of the cervix and a well-marked rectocele, as did the examination under anesthesia. The cervix and perineum were repaired July 15, 1924. The three days following operation were uneventful. On the fourth day the patient complained of cramp-like abdominal pains. There was no vomiting; the bowels were moved by enema. On the fifth day the pain had become localized in the right lower quadrant; the temperature was 101°; the leucocytes were 15,400, with 88 per cent. polymorphonuclears; and an acutely tender mass was felt beneath moderate rigidity occupying the right lower quadrant. Upon opening the abdomen through a McBurney incision a slate-colored cystic tumor was found occupying the iliac fossa. An enlargement of the incision was necessary to deliver the tumor which was then found to be a greatly distended Fallopian tube, that had become strangulated by one or more turns at its broad ligament attachment which formed its axis. The ovary was normal. The tube was removed, as was the appendix, which was normal. The subsequent course was entirely uneventful, the patient leaving the hospital on schedule time.

The patient is presented to show an unusual complication of a common operation. There was no evidence of preexisting disease of the uterine adnexa. It is possible that sympathetic muscular activity of the tube coincident with overactive intestinal peristalsis may have brought about acute torsion of the tube.

## ACTINOMYCOSIS TREATED BY POTASSIUM IODIDE IONIZATION

DR. HOWARD LILIENTHAL presented a man, aged forty-eight, who was his patient about thirty years ago. At that time he suffered from a peculiar form of subcutaneous infection of the left forearm which gradually extended to the shoulder, in spite of many operations at which the tissues were laid wide open. Eventually there was an osteomyelitis of the ulna. The radius also became involved. It was several years before final healing took place under ordinary surgical treatment.

At that time numerous attempts were made to isolate the organism causing the infection but were unsuccessful, the usual bacteria of inflammation being the only ones found. He remained well until less than a year ago, when he began to suffer from renal colic. X-ray pictures demonstrated a stone in the lower left ureter. A dentist suggested that his renal colic might in some way be dependent upon a tooth infection. X-ray examination showed a rarefaction at the root of the second right lower molar and following the dentist's advice the tooth was extracted. There followed a suppuration beneath the jaw. The wound in the mouth healed in due time, but the submaxillary infection became so severe that a wide incision was made by another surgeon. The discharge, while purulent, did not entirely account for the swelling which was present. Healing was slow and at last another superficial reddened and fluctuating area close to the wound appeared. This was incised and packed. He was seen first by the reporter in September and from a little incision which had to be made on account of another superficial abscess, there was obtained material which was sent to Doctor Mandlebaum for confirmation of a provisional diagnosis of actinomycosis, which was made on account of the characteristic "lumpy jaw" and the fact that no dead bone could be demonstrated. The pathologist at once reported positive actinomycosis. Treatment was begun with potassium iodide internally and packed with gauze in the wound. Healing was rapid, but as soon as the wound was entirely closed swelling reappeared. The local treatment by potassium iodide had been stopped when the wound was healed. Then it occurred to the reporter that ionization with potassium iodide promised to

## NEW YORK SURGICAL SOCIETY

carry the iodin ions into the region in greater concentration than could be produced by systemic exhibition. The patient during this time had become naturally somewhat nervous, and hearing of some of the good effects reported after the administration of arsphenamine, he wished to try this in addition to his other treatment. Dr. David Kaliski carried out this treatment, although he stated that the reports had been conflicting, and he did not care to ascribe any possible improvement to this drug alone. The man was sent to Dr. M. L. Rhein for treatment by ionization with potassium iodide. The swelling rapidly receded; the tissues which had been indurated became soft and an apparently full recovery has followed.

Whether this method is applicable to actinomycosis of the internal organs, such as the lung, it is difficult to determine, as well as the method of its application. In a case of mediastinal or pulmonary actinomycosis, it would be a problem whether to lay bare the diseased part and treat it directly or to attempt the ionization through the unopened skin. This case is reported merely as suggestive.

### CICATRICIAL STRICTURE OF THE OESOPHAGUS

CASE I.—DR. NATHAN W. GREEN presented a girl, three and one-half years of age, who was admitted to St. Luke's Hospital, November 3, 1921. Her chief complaint was vomiting of mucus and inability to swallow during six weeks previous to admission.

She gave the history of having swallowed some "Sani Fluid Disinfectant" (lye, creosote, etc.), three and one-half months previous to admission. For the next ten days she did not swallow anything. After the burn healed she was able to take liquids and soft solids.

November 8, 1921, under ether, using a small oesophagoscope, a stricture of a lumen of 4 mm. midway in the oesophagus was found by Doctor Green. The instrument could pass no further, but a small bougie 3 mm. in diameter passed and met resistance at the epicardia 6 cm. lower. By very gentle pressure through the 'scope, the olivary bougie was passed into the stomach. This was followed by a blunt bougie 4 mm. in diameter, which also was advanced through the tube into the stomach. (The space of the oesophagus between the two strictures appeared atrophic with small circular ridges.) Lerche's dilator was then introduced into the stomach and opened carefully to 30 F., using very little force and very slow speed. There was considerable bleeding. Both strictures were thus dilated with the intervening space.

December 1, 1921, a similar procedure was carried out. The 'scope showing the oesophagus to be a little more viable. The Lerche's instrument was then opened to 36 F. and then after withdrawing it an olivary bougie 36 F. was passed. This engaged tightly and was slowly passed into the stomach. She was discharged December 19, 1921, but was readmitted March 9, 1922, complaining of the same symptoms; and on March 11, 1922, and March 23, 1922, through an oesophagoscope the stricture was again dilated. Then April 4, 1922, through the 'scope the strictured portion was again dilated, this time to 50 of the Lerche instrument. (This equals about a 46 F. blunt-pointed bougie.) Then a 36 F. bougie passed easily into the stomach. All fluids were withheld for eight hours, then small doses of water were given. The temperature the following day rose to 100° F., but promptly dropped to normal.

She was discharged April 9, to be readmitted on October 11, 1922. Bougies were passed in the interim every two weeks and readmission was made because the bougies could not pass as readily as they should.

October 12, 1922, the 'scope was passed and the oesophagus again inspected and dilated. Bougies were then passed more frequently and the child dis-

## LUNG SUPPURATION

charged October 31, 1922, in excellent condition. Since then she has had a bougie passed approximately every month.

This case is shown to illustrate the feasibility of controlling benign strictures, which are not impervious, entirely through the mouth and without the necessity of a gastrostomy.

DOCTOR GREEN presented also a woman, aged nineteen years, who was admitted to St. Luke's Hospital, July 19, 1922. Her chief complaint was inability to swallow. Five weeks before admission she swallowed by mistake a small mouthful of concentrated nitric acid. Immediately after this she was given milk to drink and within one-quarter of an hour her stomach was washed. Three days later the mucous membrane of her mouth "peeled." She was unable to swallow for five days, but after that took fluids slowly, but no solids nor semi-solids. In the few days just preceding admission she had great trouble in getting fluids down. A röntgenogram taken by Doctor LeWald July 18, 1922, before admission, showed delay in the upper portion of the œsophagus.

July 20, 1922, a small œsophagoscope was passed. It encountered resistance a little below the upper sphincter of the œsophagus. A bougie was passed through this and the 'scope advanced further. A bougie was then passed to a length of eleven inches. The œsophagus was very red and bled easily in places. It had the appearance of a granulated surface. She was discharged July 22, 1922, to return the following week for further dilatation. She was readmitted July 25, 1922, somewhat improved but not yet swallowing semi-solids.

July 26, 1922, she had a gastrostomy performed by Doctor Green under local anaesthesia. The Stamm-Kader type was used. August 18, 1922, under ether anaesthesia, the Abbe string-sawing operation for stricture of the œsophagus was done and the œsophagus was opened up to a 38 F. bougie. After this the gastrostomy was kept open for further use until sufficient dilatation should have been accomplished.

August 25, 1922, this procedure was again gone through, dilating the œsophagus yet more. Only a whiff of ether was necessary during this operative procedure. She was discharged August 24, 1922, very much improved and swallowing easily. After this the gastrostomy was allowed to heal and bougie dilatations were instituted. At first three times a week, then once a week, and later once a month, and now about every two months.

She is well, has gained weight, and can readily perform her daily duties.

In this case it was necessary to do a gastrostomy on account of the impervious condition of the stricture to instrumentation orally.

## LUNG SUPPURATION

DR. NATHAN W. GREEN presented a man, aged fifty years, admitted to St. Luke's Hospital, November 22, 1924, with a diagnosis of appendix abscess. His chief complaint was pain in the abdomen for two weeks. He was operated on by Doctor Schley, December 4, 1924, under ether anaesthesia. The appendix was found retrocaecal and surrounded by recent and very friable inflammatory tissue. It was removed.

January 2, 1925, a bedside note was made stating that the patient coughed a good deal at one time during the previous night. The following night he had profuse diaphoresis, and that day, January 3, 1925, went to the X-ray room. He apparently coughed until January 11, when the bedside note stated that the mucus expelled had a foul odor.

The report of the X-ray as of January 3, 1925, indicated a fairly large

## NEW YORK SURGICAL SOCIETY

cavity in the upper lobe of the right lung. On the same day his temperature ranged between  $101\frac{2}{5}^{\circ}$  to  $102\frac{3}{5}^{\circ}$  F.

January 16 it reached  $103\frac{3}{5}^{\circ}$  F., touching  $102^{\circ}$  twice on January 20. He was operated upon under local anaesthesia on January 21, 1925. His temperature did not go above  $101^{\circ}$  but once till the time of his discharge from the ward. This exception was after the second stage of the operation for lung suppuration. Then it reached  $101\frac{2}{5}^{\circ}$  F.

He was discharged to the Out-patient Department for care twenty days after the first stage and twelve days after the second stage of his operation for lung abscess with a temperature of  $98^{\circ}$ , pulse 80, and respiration 20.

At operation on January 21, 1925, under local anaesthesia, the first stage of the operation for lung abscess was done. A mid-axillary incision was made extending down from the apex of the axilla for four inches. The second and third ribs were resected for three inches. The parietal pleura was stripped from the under side of the ribs and this was pushed inward by packing down on it with iodoform gauze, thereby compressing the upper lobe of the lung to some degree.

At the second stage the parietal pleura was opened. It was then firmly adherent to the visceral pleura. The lung abscess was explored by first inserting a needle and obtaining pus. By passing a grooved director down on the needle and stretching the tissues the abscess was opened. Then the opening was enlarged by stretching with dressing forceps. The interior of the cavity was then explored by the index finger and found to be about 5 cm. in diameter. A double rubber tube was inserted directly into the cavity and held in place by gauze packing. His Wassermann was negative. Since being discharged from the ward (one month ago) he has gained over twenty pounds, "is spitting very little and has but a moderate drainage sinus. He was shown to illustrate the method and the ease of approach under local anaesthesia.

DOCTOR GREEN presented also a boy, aged fourteen years, who was admitted to the Surgical Service of St. Luke's Hospital (Division A), May 17, 1920. His chief complaint was a cough and expectoration of purulent material for nine years. At the age of five the patient had a severe case of whooping cough with relapse, following which he began to have a persistent cough. Since he can remember he has coughed only at intervals, three or four times a day. Cough is usually brought on by a change of posture.

Upon examination of his thorax, the left lung appeared normal throughout. The right lung showed dulness and diminished voice and breath sounds with decreased fremitus over the right base posterior and laterally. After repeated bronchoscopy and X-ray and readmissions his right chest was explored by opening in the intercostal space and spreading the sixth and seventh ribs.

September 9, 1920, the first operation was done by Doctor Green. Exploratory of the right pleural cavity. The lower lobe was found collapsed and no crepitant present. There were a few adhesions. Ribs were not resected. The lower lobe was sutured to the chest wall. Some pus escaped during the suturing by the stitches. A drain was placed into the dead space below the lower lobe.

The second operation was done September 28, 1920. It was drainage of the abscess cavity. Five inches of the sixth and seventh ribs were resected. On returning to the ward he coughed up a rusty steel pin without a head about two inches long. He had no recollection of having inhaled this, but from appearances it had been in the lung a long time.

After repeated discharges and readmissions and X-ray and bronchoscopic

## CHRONIC SUPPURATIVE PYELONEPHRITIS

examinations he was again readmitted July 18, 1924, with the following interval history: After operation on the bronchiectatic cavity in December, 1921, the patient had gradually gained weight up to 145 pounds (his present weight), but about every eight hours he coughs up nearly one-half pint of yellowish-green foul-smelling material, and occasionally he had coughed up a little blood after violent exercise. An X-ray taken July 21, 1924, showed a series of bronchiectatic shadows in connection with the lower portion of the expansile area of the chest.

July 22, 1924, the first stage of an extra-pleural collapse of the right lower lobe was performed. A vertical incision posteriorly was made removing parts of the tenth, ninth, eighth and seventh ribs.

On August 5, 1924, the second stage was done by an anterior incision more or less vertical; parts of the sixth, seventh, eighth and ninth ribs were removed.

September 3, 1924, the third stage of the operation was accomplished. By means of an oblique incision over the fifth rib, the removal of the inter-medial portions was effected.

His sputum was negative for spirilla and for tubercle bacilli. He was discharged fifty-five days after the first stage, forty-one days after the second stage and twelve days after the third stage of the operation. He now states that his sputum although not entirely absent, is much less in quantity and the odor is not so offensive. He is still supplementing this collapse therapy by postural drainage each day.

DR. HOWARD LILIENTHAL said as to cases of lung suppuration in which extra-pleural collapse was done, he did not think that this procedure accomplished very much good. As a matter of fact, there is a very great difference between the lung collapse method in this condition and that of tuberculosis. In the latter the aim is to secure absolute rigidity of the chest wall, for if one can stop the breathing and motion of the ribs on that side the tuberculosis may become arrested. But in lung suppuration there is a different state of affairs. There must be drainage and in extra-pleural thoracoplasty one will do good only insofar as one can facilitate the drainage. The idea is to get air in. The two diseases are entirely different and react differently to the same procedure.

## CHRONIC SUPPURATIVE PYELONEPHRITIS

DR. NATHAN W. GREEN presented a woman, age fifty-six years, who was admitted to St. Luke's Hospital, June 12, 1922. Her chief complaint was "falling of the womb" for seven months with pain and swelling of the legs. For the past seven months she had suffered great fatigue and pain in the small of her back. She has had eight children and a breast abscess seventeen years ago. Otherwise there was nothing unusual except that she did not walk until six years of age.

Upon physical examination she presented the picture of uterine prolapse; but she also had a hard mass in her right side at the level of the umbilicus extending into the right flank. Of this more important finding she did not complain. A Röntgen examination showed a shadow of irregular density just to the right of the interval between the second and third lumbar vertebra. There was also some delay of the opaque feeding in the lower end of the œsophagus. The œsophagus was 'scoped under local anaesthesia by Doctor Green and the mucous membrane appeared to be normal throughout. The

## NEW YORK SURGICAL SOCIETY

cardia was examined and found to be functioning well. No dilatation nor retention of food was present. The röntgenogram also suggested calcification of a tumor mass.

June 22, 1922, Doctor Green made a mid-right rectus incision by which in the right flank and anteriorly was uncovered the tumor which was about as large as a grapefruit, hard to palpate and adherent to the surrounding perirenal fat and to the ascending colon. The kidney was incorporated in this mass. There were a number of hard lymphatic glands in the mesentery of the ascending colon and in the retroperitoneal tissues. At the pylorus an area of scarring was seen, being the remains of an old ulcer. The left kidney was normal. The gall-bladder was small, soft and without obvious pathology. After exploring the abdominal cavity the kidney tumor was removed as follows: The outer leaf of the mesentery of the ascending colon was incised, freeing the retro-peritoneal tumor mass from the adherent perirenal fat. The pedicle of the kidney was then ligated *en masse* and its components separately. The ureter was then cut and ligated. After freeing from the colon, and some necessary repair, the posterior peritoneum was closed. The anterior peritoneum was then closed and the abdominal wound closed without drainage. Healing was per primam. July 8, she was discharged completely healed.

The pathological report was chronic suppurative pyelonephritis with nephrolithiasis. The specimen comprised a kidney 11 x 8 x 6 cm. A multi-lobular cystic mass was revealed with no vestige of renal tissue visible. The ureter was not patent. Section showed a large quantity of thick greenish-yellow pus. Since this focal infection was removed she has gained weight, looks ten years younger, and is greatly improved in health. His purpose in presenting this patient was to bring out discussion regarding the advantages of this anterior approach for removal of the kidney. The ease of access to the pedicle by this method was worthy of note.

DR. CHARLES H. PECK said he had had a case of a seven months' old baby in which the diagnosis was splenic tumor. At operation the spleen was found to be normal, the mass being a tumor of the left kidney. The abdominal approach was continued for the nephrectomy and the speaker was struck with the ease of the approach and the control of the pedicle. He has always used the posterior route in kidney tumors and usually found it satisfactory, but now feels that the transperitoneal route may be a better method in some cases. The patient made an excellent recovery.

## BILATERAL MAMMARY CANCERS

DR. CLARENCE McWILLIAMS presented a woman, fifty-eight years of age, who was first seen by him in September, 1910, with a walnut-sized tumor in the outer upper quadrant of the left breast. In September, 1910, at the Presbyterian Hospital, this tumor was removed and the frozen section examined, which demonstrated the growth to be carcinoma. A radical removal of the breast with clearing out of the axillary contents was done immediately. Pathological examination of the axillary contents showed no node involvement. Six years later she returned with a small tumor in the outer upper quadrant of the right breast which was removed in April, 1916, the method of procedure being the same as in the previous tumor and the presence of cancer in the tumor having been demonstrated by examination of a frozen section previous to extirpation. Pathological examination showed no carcinomatous involvement, although an enlarged node found in the axilla at the time of operation was demonstrated not to be cancerous. She was presented to instance the

## BILATERAL MAMMARY CANCERS

belief of the author that many of the bilateral mammary cancers are independent primary growths, also that local excision of the tumors for frozen section diagnosis is harmless, provided the radical operation be at once performed if cancer is found. This woman is alive without recurrence fifteen years after the first operation and nine years after the second.

The reporter does not think that it is necessary to emphasize that cancer is a local disease in the beginning if radical operation be performed before node involvement. Rodman has shown that 65 per cent. will be alive five years after operation for mammary cancer while only 30 per cent. will be alive five years after operation if the nodes were involved. The prognosis therefore in any given case depends largely on whether the nodes are involved or not, hence the irrationality of giving pre-operative X-ray treatments before operating in mammary cancer, for by adopting that plan from two to four weeks' time is lost, during which period node involvement may take place, thus diminishing the ultimate prognosis by at least 30 per cent. Such treatment is not based on any scientifically demonstrated facts. This patient has had no X-ray treatments at any time, which illustrated the fact that if the surgeon gets out all cancer cells by his operation, the patient remains well. If not, a fatal result will be inevitable, despite all X-ray treatment, the only effect of which can be to delay the fatal outcome.

DR. GEORGE WOOLSEY said that he believed most of the bilateral tumors were recurrences. It has been shown by Kilgore that if a patient has survived five years after removal of the breast for carcinoma, that patient is three or four times more likely to have carcinoma of the other breast than a normal person of the same age. The second breast is infected by permeation of the lymphatics. Judd found in the Mayo Clinic the late involvement of the second breast in 10 to 12 per cent. of cases when one breast was removed. As regards radiation, the speaker did not favor pre-operative radiation of cancer of the breast; only post-operative.

DR. JOSEPH WIENER referred to a patient of his from whom he removed a nodule in the breast in 1900. It proved to be adenocarcinoma, and he did a radical removal. Eleven years later she came back with a rapidly growing scirrus of the opposite breast. Again radical operation was done. This was in 1911. Last year she invited Doctor Wiener to her seventieth birthday party. The speaker did not believe one should consider the scirrus a recurrence. Bloodgood has stated that if a benign tumor is removed from one breast, any subsequent tumors will not be malignant; Doctor Wiener thought that a dangerous doctrine to promulgate because it does not hold in every case. In regard to radiation, he had never heard that surgeons were in favor of pre-operative radiation. He had been giving radiation post-operatively for seven or eight years, and in every case of carcinoma of the breast that he had removed he has treated the patient himself subsequently. A patient of his developed ulceration of the skin following radiation and the pathologist found dead carcinoma cells killed by radiation.

DR. HOWARD LILIENTHAL said he did not agree with Doctor Wiener's logic that because a few cancer cells are killed after operation that none of them will be killed before. Cancer cells, if under the skin, are hard to kill. He has, for the past four years, been radiating pre-operatively every case

## NEW YORK SURGICAL SOCIETY

of carcinoma of the breast. He is not prepared to say that the cases did better because of this, for in two there was rapid recurrence in spite of the pre-operative radiation, and he is inclined to think he will give up pre-operative radiation. He took it up on account of experiments published abroad, but Francis Carter Wood has changed his opinion. Doctor Wood says that the skin takes up so much of the X-ray effects that unless one kills the skin, what is under it will not be killed.

### FREE, FULL-THICKNESS SKIN GRAFTS

DR. CLARENCE A. McWILLIAMS presented a number of patients illustrating the uses of free, full-thickness skin grafts. The advantage of these grafts is that there is no subsequent contraction. The difference between the free, full-thickness graft and the pedicled graft was in the circulatory system. The blood supply of the skin comes from vertical off-shoots from longitudinal vessels in the subcutaneous fat. Free grafts get their blood supply by osmosis from the underlying raw base; hence pressure on the graft is essential to make close contact. Pedicled grafts get their blood supply from vessels running through the pedicle; hence pressure would obstruct this free blood supply, and consequently is inadvisable. As to the technic, the essentials of success in grafting free, full-thickness, non-pedicled grafts are as follows:

1. Clean operative wounds are best of all, though sterile granulations are not unfavorable.
2. The base must be smooth and, best of all, muscle or fascia. In some cases they have been successful on the skull bones, the dura mater, the periosteum and the tendons, such as the Achilles.
3. No fat should be on the under surface of the graft (Davis, Blair, New), this being trimmed off with scissors. Gillies says that fat on the under surface of the graft makes no difference in its viability(?)
4. The base must be perfectly dry without any oozing.
5. There should be just as little handling and pinching of the grafts with the forceps as possible, sharp hooks being used to lift the graft.
6. The graft should be perforated in a number of places, to allow the blood or secretions to escape from under them (Davis). In addition, these perforations afford an increased means of entry of serum into the graft for its nourishment.
7. The graft should be transplanted to its new bed as quickly as possible after its excision, so as not to compromise its nutrition, and it is advisable to transfer it dry without immersion in salt solution, to favor more securely its adhesion.
8. The most unfavorable base on which to place a free, full-thickness graft is fresh fat, as through this fat very little blood can pass. In such a case, the fat should be allowed to granulate before grafting on its surface.
9. Gillies makes the point that it is well to put some tension on the graft, equal to that in the position from which it was removed, since this stretching favors easier absorption of serum from the bed; hence the graft should not be cut any larger than the space to be filled.
10. Most essential of all is to apply very firm, even pressure on the graft, and to keep the parts absolutely immobile, and not to disturb the dressing for about seven days. Davis uses a sea sponge for this purpose.

### X-RAY DERMATITIS OF PALMS

11. The epithelial layer of the graft may slough, but this does not injure the deeper skin layers.
12. Free, full-thickness grafts, taken from hair-bearing areas, may be successfully transplanted into eyebrow defects, with a subsequently resulting growth of hair in the graft. In such hair-bearing grafts, a very thin layer of fat should be left on the graft, since the hair follicles project into the fat.
13. The healthy prepuce, removed by circumcision, portions of the scrotum and the eyelids make very successful free, full-thickness skin grafts, since they do not contain fat.
14. Free, full-thickness grafts should not be cut larger than 3 inches long by  $1\frac{1}{2}$  inches wide. A large area should be covered by such individual segments, each being stretched and sewed in place.

### X-RAY DERMATITIS OF PALMS: ABDOMINAL FLAP

DR. CLARENCE A. McWILLIAMS presented a woman, of fifty-two years, who shows the deplorable results that can be produced by X-ray treatments. This patient had had an eczema of the hands for six years. Treated by all kinds of dermatological experts without any good results. Two years ago she was subjected to X-ray treatments to each hand, a dozen treatments at intervals of a week. These treatments did no good whatsoever. The itching she had was intolerable. This has increased since and to it has been added an intense burning. The right hand palm is the seat of a chronic indurated dermatitis covered with crusts and scales and cracks extending on fingers and thumb down to second phalangeal joints and to wrist. The right palmar skin is very thick, the result of the X-ray treatments, a regular fibrosis of the skin. This thick skin frequently cracks and is prone to develop carcinoma. In the palm of the left hand there developed an ulcer four months ago. This was clinically diagnosed as cancer and removed by the diathermic knife, but no pathologic examination was made. She was later sent to the reporter for plastic operation to correct the operative sequelæ. In the course of this procedure the whole superficial palmar layer was removed, uncovering the tendon sheaths. To cover the raw area a pedicled skin flap was raised from the abdomen, lifting up three sides of the flap and closing the resulting raw area by undermining the edges or failing this by immediately Thiersch grafting the raw area. Thus the secreting raw area is done away with. The disadvantage of the pedicled flap is the fat which one must leave on its under surface to assure its sufficient blood supply. This fat must be removed in a subsequent operation. On this patient's right hand it is proposed to place one large full thickness free graft after removing all the skin.

There is about an 80 per cent. chance that it will take. If it does not take, no harm will be done and the defect can then be covered by a pedicle flap from the abdomen. The edges of the flap were then sutured to the edges of the raw area and held to the abdomen by bandage.

On the twelfth day after the previous operation, a clamp was put on compressing one-quarter of the pedicle close to the abdomen. On successive days the clamp was advanced one-quarter of the flap more, until the day before the final operation the clamp was on the whole pedicle for twenty-four hours. The entire flap was then cut away and sutured in position to the remaining edges of the raw area of the hand. The hand was put on a wooden splint. Primary healing throughout followed. The fingers were naturally very stiff and efforts had been made by active and passive motions and baths to limber them up. These efforts are slowly succeeding. Just as soon as they are fully limber, the right hand will be attacked, removing the thick palmar

## NEW YORK SURGICAL SOCIETY

skin and covering the defect with a full thickness free skin graft from the abdomen. The chances are that the ulcer on the palm was of the prickle cell variety which will require dissection out of the axillary nodes.

### CARCINOMA OF THE RECTUM AND RECTO-SIGMOID

DR. JAMES I. RUSSELL read a paper with the above title, for which see *ANNALS OF SURGERY*, May, 1925, vol. lxxxi, p. 972.

DR. CHARLES H. PECK said that in reviewing his own cases of the last ten years, he had found them a very discouraging group because so many of them are in the later stage of the disease when first seen. In his own group of 44 cases he had found an operability of only 50 per cent. and he lost 7 out of 22 radical operations. He had tried every method he ever heard of, in the way of technic, and had not settled down to any one method. Cases varied in the extent of the growth and in position. In one group the best method of approach was to first do a laparotomy to determine if there were any secondary nodules and also the extent of the growth and decide on further procedure. In some, he had been able to go ahead with a one-stage operation. In one case in particular, the sigmoid was so long and lax that he was able to do this, making a perineal anus, and the woman is now alive and well, six years after operation. There was no tension and there was ample room to do it. She has pseudo-control because the tissues healed well around the opening, and is very comfortable. In another case he had been able by a combined one-stage operation to invaginate the growth downward through the anus and allow the freed portion to become necrotic. Recovery was satisfactory and the patient left the hospital in good condition, but died later from the effect of a stricture at the site of anastomosis. Those cases are the exception. Doctor Peck referred to a case he had seen with Doctor Russell of the smallest carcinoma he had ever observed; it was discovered through the sigmoidoscope. It was hardly bigger than the head of a pin and was difficult to identify as a carcinoma. Radical operation by Doctor Russell was done and the patient is now well, after three and a half years, and has every expectation of being completely cured. If every patient were seen at that stage, the whole group would have a different aspect. One patient in whom carcinoma had been discovered at a very early stage when it was very tiny, had been advised to submit to operation but refused. Two years later he was brought to the hospital with complete obstruction from massive carcinoma and died in twenty-four hours. The life of that case from its earliest manifestation to its ultimate termination was two years. He had another case of a carcinomatous mass in the pelvis which seemed inoperable and the patient was not expected to live many months, but after a palliative colostomy went on for three and a half years. They vary very much in malignancy and in the rate of growth and unfortunately 50 per cent. of them first come to the surgeon when the mass and gut are fixed to the surrounding tissue and in a stage that should be considered inoperable by radical methods.

DR. HOWARD LILIENTHAL said that first of all before operating on any case of carcinoma of the rectum he has invariably had the chest X-rayed.

## CARCINOMA OF THE RECTUM AND RECTO-SIGMOID

Although the lungs are not the commonest seat of metastasis, it does occur there, and in two cases he was saved from doing an operation when metastasis was already established in the lungs. His other invariable procedure was to send to a man experienced in the use of radium all cases of inoperable carcinoma of the rectum. The first case in which he did this was a woman who was made worse and the disease did not seem to be affected by treatment with radium. The next patient was a man who had syphilis and diabetes and an enormous mass with a huge crater against the prostate. It did not appear as if he could stand operation and Doctor Quick was asked to treat him with radium. A specimen was removed by Doctor Quick and examined by Doctor Ewing and pronounced malignant. That man is now apparently well and there is no sign of any growth. He suffered extremely under the treatment and had to be given large doses of morphine. He still has paresthesia, but he weighs more than ever before. This was unquestionably carcinoma of the rectum. In the next case the same picture was present, but the man developed a perforation between the rectum and bladder and had foul-smelling urine. After the application of radium that opening closed. He was watched for over a year, and while the tumor did not disappear, its development became slower. The recto-vesicle fistula, however, closed up.

DR. GEORGE WOOLSEY said that one of the secrets of success in these cases of carcinoma of the rectum, as in all carcinomas, is early operation. He thought that was one reason why the case he was to have presented at the last meeting had such a long post-operative life, *i.e.*, twenty-three years and over. Another patient on whom he operated two and a half years ago was a comparatively early case, four weeks after symptoms developed. Yet at the time these cases were first examined the cancer was quite extensive. The glands of neither of these two cases were involved. The speaker expressed himself in favor of colostomy even in the low operation. It enables one to explore the abdomen if an opening somewhat larger than necessary for the colostomy is made. In the last case he was compelled to make the colostomy secondarily on account of some sloughing at the lower end of the gut. In the lower part of the gut the circulation is not always very good and there is danger of sloughing. The choice of operation should depend on the site, extent and duration of the tumor. He remembered two cases in the ward at Bellevue at the same time, both under thirty, which were very rapid in onset and recurrence. There are a number of these cases under thirty years of age.

DOCTOR RUSSELL, in closing the discussion, said that Pfeiffer, in reviewing cases of carcinoma in children, speaks of the rapidity with which the tumor grows, death occurring within six months of onset. The choice of operation depends on the patient, but the abdominal-perineal operation was the one of choice with the speaker. As to the question of discovering carcinoma as an early small growth, he had had two cases in which the earliest symptom was bleeding and both had been operated on for hemorrhoids. The diagnosis was made by sectioning through a sigmoidoscope. In reply to a question as to the operative mortality, he had 16 deaths in 45 radical operations within three

## NEW YORK SURGICAL SOCIETY

months, about 35 per cent. Twelve others were believed to have died within a year.

*Stated Meeting Held March 25, 1925*

The President, DR. EUGENE H. POOL, in the Chair

### PELVO-ABDOMINAL TUMOR DISSIPATED BY X-RAY THERAPY

DR. FRANK S. MATHEWS presented a man who had first applied for treatment December 27, 1924. He had left congenital cryptorchid. For the past six months, he had noted a swelling in the lower abdomen which filled the entire pelvis and spread out on either side into the false pelvis and reached to the level of the umbilicus. By rectal examination, a tense tumor flattened out the rectal wall and was firmly fixed. The veins in the lower abdomen were engorged, as were also the superficial veins of both legs, and edema of the legs extended up to the knees. An abrasion over the right shin had failed to heal, was surrounded by an area of discoloration and seemed about to form an indolent ulcer. The provisional diagnosis was an inoperable abdominal sarcoma, probably originating in the cryptorchid. The patient was referred for radio-therapy to Dr. F. C. Wood, who has given him eight treatments, the first being January 5. The following ones were the 9th and 20th, after which the tumor had disappeared. These treatments were heavy, about 90 per cent. of an erythema dose, at 200 K.V., with .5 mm. copper and 1 mm. aluminum filters. The subsequent treatments have been lighter prophylactic doses. To-day the engorgement and edema of the limbs has disappeared, the abrasion has healed and no tumor can be made out.

DR. WILLIAM B. COLEY said that he had examined Doctor Mathews' patient very carefully and had been unable to find any trace of anything abnormal in the abdomen. The case in his judgment shows that a very large inoperable abdominal metastasis, following sarcoma or teratoma of the testis, may disappear under either X-ray or radium treatment. Doctor Coley recalled a case in his own experience at the Memorial Hospital some eight years ago, in which a tumor, considerably larger than the one found in Doctor Mathews' case, had disappeared under a single treatment of radium (12,000 mc. hr. at 10 cm. distance); the tumor had nearly disappeared at the end of three weeks; at the end of a month, it had entirely disappeared and the patient gained considerably in weight. At the end of four months, however, the disease recurred, causing death in six months. The recurrent tumor showed little effect from further radiation. In Doctor Mathews' case, Doctor Coley believed that the tumor would probably recur and prove fatal in the end. In his opinion, the number of permanent cures in sarcoma of the testis would be greatly increased if prolonged treatment with the mixed toxins of erysipelas and *Bacillus prodigiosus* were used as a routine measure immediately after primary removal of the tumor. Doctor Coley referred to one of his previous publications on *Cancer of the Testis*, containing a report of 64 cases personally observed, with special reference to 12 cases of cancer of the undescended testis. In only one of the latter group of cases had a permanent cure been obtained; this was a case which had been operated upon by Dr. Howard Lilenthal, in December, 1908; immediately after prolonged toxin treatment was begun and carried out under Doctor Coley's direction;

## RECONSTRUCTION OF FOREARM AND HAND

the patient is well at the present time, over sixteen years later. Another case which he recalled had been referred to him in July, 1908, by Dr. John B. Murphy, after he had removed a very large round-cell sarcoma of the undescended testis. The toxins were given for nearly a year; the patient remained well for three years and then died of probable metastasis of the lung. Doctor Coley then described a case which he believed showed that much could sometimes be accomplished in far advanced inoperable cases treated by a combination of the local effect of radium with the systemic effect of the mixed toxins: The patient, a man of forty-two years, had been referred to Doctor Coley by Dr. Charles H. Mayo, in July, 1919, with a large inoperable abdominal recurrence, together with metastasis in the supraclavicular region, left side, the size of a hen's egg. Under a combination of toxin- and radium-treatment the mass apparently entirely disappeared. The toxins were kept up with occasional intervals of rest for several years, and he received a radium-pack treatment annually. He remained in good health until a couple of months ago, when he began to have symptoms of pain and discomfort in the region of the duodenum; although no palpable tumor could be discovered, exploratory operation done a week ago revealed a mass of enlarged glands in the upper abdomen just behind the duodenum.

DR. CHARLES GORDON HEYD referred to a case in which he had operated for a sarcoma of the testicle. After orchidectomy an exploratory laparotomy was done which revealed a mass of glands along the aorta leading up to a larger mass surrounding the left kidney. Histological examination of the kidney tumor was the same as the testes. This patient was treated with radium and at the end of a year had no clinical or X-ray evidence of sarcoma. This patient was operated upon in 1919 and he has remained well ever since.

## RECONSTRUCTION WORK AFTER EXTENSIVE LACERATION OF FOREARM AND HAND

DR. KIRBY DWIGHT presented a man, twenty-eight years of age, who in August, 1922, was struck by a Fifth Avenue bus and was dragged some distance. He was brought to Roosevelt Hospital and was operated upon at once. The following injuries to the right forearm and hand were found:

The skin, together with the subcutaneous tissue and deep fascia, had been torn almost entirely from the forearm, from just above the elbow to the wrist. Only a narrow strip about 6 centimetres in width had been left, extending from the medial side of the elbow to the anterior aspect of the wrist; and this had been separated from the deeper structures so that it formed a bridge. All the superficial muscles of the forearm were exposed and the extensors carpi radialis longior and brevior and the extensor communis digitorum were badly crushed and lacerated. There was a compound fracture of the middle third of the shaft of the radius, with the upper end of the lower fragment projecting backward through the muscles, and there was a posterior dislocation of the head of the ulna. The skin and palmar fascia had been torn from the entire palm, exposing the flexor tendons of the fingers. The thumb had been denuded of skin except over its distal phalanx, and the small muscles of the thumb had been destroyed almost entirely. All the fingers were lacerated. Circulation and nerve trunks were not injured.

The operation consisted in a careful débridement, as it was realized that

## NEW YORK SURGICAL SOCIETY

the hope of saving the arm depended on the prevention of infection and the saving of the bridge of skin extending from the elbow to the wrist.

Nothing was done at this time to the bones, as the condition of the patient did not warrant any further operative procedure.

Dakinization was started at once. The manipulation of the arm was exceedingly painful, especially during dressings, so at the end of five days the arm was suspended by means of tongs in the radius. Suspension by the fingers was impossible owing to their laceration. This procedure added greatly to the comfort of the patient.

By the nineteenth day the granulations over the upper part of the forearm were ready for grafting, so this was done, using small deep grafts. At the same time the radius was wired after cutting away the tip of the lower fragment, which was exposed and had become necrotic.

During the fifth week Thiersch grafts were placed on the hand and the grafting of the forearm was completed.

In the ninth week the silver wire was removed from the radius, six weeks after it had been inserted. Union was firm; there were no sequestra.

Six months after injury there was no pronation or supination and the wrist was held in abduction due to the relative lengthening of the ulna. X-ray showed a bony bridge between the ulna and what had been the upper fragment of the radius. This was noticed now for the first time but the original callus must have been laid down while the fracture was still unreduced.

An incision was made over this bridge posteriorly and it was chiselled away. Then the head and about 3 cm. of the shaft of the ulna were removed subperiosteally.

Pronation and supination immediately became free, but the wrist remained fixed in abduction. There was a synostosis between the radius and the semilunar, caused, no doubt, by an inflammatory process set up by the tongs, and extending down to the wrist-joint.

One month later the semilunar bone was excised, using a posterior longitudinal incision medial to the extensor tendons of the fingers. As soon as this was done motion in the wrist became free.

About a year after his injury the patient entered the hospital for the fourth time, in order to have a plastic operation done on the palm of his hand. At this time the palm was much contracted, drawing the fingers together: motion of the fingers was limited and occurred principally at the metacarpophalangeal joints. The flexor muscles in the forearm had been developed considerably by a system of exercises he had been taking.

The scar tissue of the palm of the hand was dissected out. The tendons of the ring and little fingers were adherent to the scar, but those of the index and middle fingers were perfectly free. A pedicle flap was made from the skin of the abdomen and sutured in place on the palm. The pedicle was cut after twenty-one days. It was at first intended to have the pedicle sufficiently large to bring around and cover the thumb, but it had contracted and especially narrowed so much in the twenty-one days that this was not feasible.

About five months after this the patient entered the hospital for the fifth time. The hand was much improved; the palm was not so much contracted and the fingers were not drawn so much together. There was good active flexion at the metacarpophalangeal joints, but in so doing the fingers themselves remained straight. However, if some one held the proximal phalanges extended, the patient could actively flex the interphalangeal joints.

The logical explanation for this phenomenon seemed to be that there was a lack of balance between the flexors and the extensors of the fingers. The

### SIMULTANEOUS CARCINOMA OF BOTH BREASTS

flexors and perhaps especially the lumbrales had become powerful through exercises in flexion, while the extensors had not been so exercised. In addition the latter had been the ones injured in the accident and had suffered actual loss of substance. And they might be hampered by the scar tissue at the site of the compound fracture. The motion that the patient could not do was to hold the proximal phalanges of the fingers extended by means of the extensors, while he flexed the middle and distal phalanges.

The scar tissue at the site of the fracture was removed, and although no actual adhesion to the muscle could be found, yet the function of the fingers seemed to improve a little soon after.

Since then the patient has been trying to use the hand in a normal natural way and has been exercising the extensor muscles instead of the flexor group. Considerable improvement has taken place; on active flexion of the fingers the interphalangeal as well as the metacarpo-phalangeal joints are bent.

### SIMULTANEOUS CARCINOMA OF BOTH BREASTS

DR. JAMES M. HITZROT presented a woman, age forty-seven, who was referred to him by Doctor Borland, of Lynbrook, on May 22, 1922, with a history of a lump in the left breast which she had noticed two weeks before that date and which attracted attention because of a drawing sensation in that breast. Twenty years ago, following the birth of a child, the patient had small lumps in both breasts. She has had a small lump in the right breast which she thinks she has had for a long time, but has noticed no recent change in it.

Examination of the breasts shows a small hard irregular nodule in the left breast in the upper outer quadrant slightly adherent to the skin, but otherwise movable. There were palpable nodes in the left axilla which were not large nor particularly hard. There was a similar nodule in the right breast but no palpable nodes in the right axilla.

May 23, 1923, the left breast was removed through an elliptical incision. Examination of a frozen section showed the tumor to be an adenocarcinoma. Further radical excision of the axillary contents and pectoral muscles was then done. The right breast was then removed by radical excision with skin graft to cover the area not closed by suture of the skin.

The pathological report of specimens of both breasts with pectoral muscles and axillary contents is as follows: The left breast is the seat of two hard, poorly circumscribed nodules having the gross features of carcinoma. The axillary contents contain slightly enlarged and opaque nodes. The right breast is the seat of a single hard, honey-combed nodule (about 1 to 1½ cm.), also having the gross features of carcinoma. Some of the axillary nodes are slightly enlarged and opaque.

Under the microscope the sections of all the tumors of both breasts have the features of adenocarcinoma. The lymph-nodes in both axillæ show involvement.

The patient left the hospital sixteen days after the operation and has had no post-operative X-ray treatment. The patient has gained weight since the operation and now, approximately three years after the operation, is entirely well and free from any signs of recurrence.

DR. WILLIAM B. COLEY said he had observed a number of cases of bilateral breast tumor. He could recall some six or seven at the present moment. He had had, however, only one case of simultaneous development of breast cancer, and this had occurred in a young girl, twenty-one years of

## NEW YORK SURGICAL SOCIETY

age, and had, apparently, been produced by a severe local trauma. This patient had fallen upon an icy pavement, severely bruising both breasts; two or three weeks later, tumors developed simultaneously in both breasts and grew very rapidly; the glands in both axillæ were involved. Although he did a complete radical operation, consisting of the removal of both breasts and the glands in the axillæ, a recurrence took place in about six months, causing death in less than a year. He also recalled a case of carcinoma of both breasts which had been apparently permanently cured. This patient, in 1906 and 1907, had had two operations performed on the left breast; microscopical diagnosis: fibroadenoma; in the same year, the entire left breast was removed. One year later a recurrence developed in the right breast; removal was done in February, 1908. Microscopical diagnosis: typical carcinoma. In February, 1909, there was a hard, carcinomatous mass occupying the entire left pectoral region with involvement of the cervical glands from the clavicle nearly to the mastoid. An absolutely hopeless prognosis was given to the patient's family; however, at their urgent request, Doctor Coley finally consented to try the toxins in the hope of possibly retarding the progress of the disease. The treatment was carried out at home by Dr. William J. Bott, of Palmyra, New York. Immediate and striking improvement took place with the first few weeks; the treatment was kept up for nearly two years; the patient remained well fourteen years, but this patient's family physician now informs him that, a few weeks ago an apparent recurrence was noticed in the axilla, which he intended to remove. The case will be more fully reported later.

### PULSATING EXOPHTHALMOS

DR. JAMES M. HITZROT presented a woman, age thirty-seven, who was admitted to the New York Hospital, August 20, 1917, complaining of a roaring noise in her head and loss of sight in the left eye. The woman had been a patient at the New York Hospital for a varying number of conditions since 1906. In 1911, she had an operation for suppurating inguinal adenitis (bubo) and bilateral purulent salpingitis. In 1915, she began to have headaches, dizzy spells and pains over the left side of the head and vomiting attacks following a blow which she thinks she received over the left side of the head. At this time she had disturbance of vision in the right eye, some loss of external rotation in that eye, and a four plus Wassermann. The X-ray showed roughening and irregularity of the sella turcica which was possibly due to an osteoperiostitis of the bone. During this period examination showed the field of vision limited in both eyes, more so on the right. There was œdema of the right optic nerve, the vessels were engorged and the pupil dilated and immovable. She was placed on antiluetic treatment, which was rather irregularly carried out because of the patient's irregular attendance.

In June, 1917, she was readmitted to the hospital complaining of a roaring noise in her head and difficulty in vision. There was a loud bruit over the entire head, most marked upon the left side, but well heard over both eyeballs. In the inner angle of the left eye there was a pulsating vessel with a distinct thrill, which thrill disappeared after compression of the left carotid artery. The field of vision was markedly limited in both eyes, most marked on the right eye in which there was practically no sight whatever, with atrophy of the optic as described. The left optic nerve was swollen and the vessels engorged.

### ACUTE PERFORATED PYLORIC ULCER

There was marked exophthalmos in both eyes. Operation was advised and refused.

In August, 1917, the patient returned to the hospital practically blind and consented to operation, which was done by the method of Porta. Through a transverse incision at the base of the neck the common carotid artery was occluded, by a strip of chromicized pig's bladder (Baer's membrane), about 0.5 cm. wide, which was tied about the common carotid artery until it almost occluded that vessel and only a very faint pulsation could be felt distal to the ligature. The intention was to completely occlude the vessel if no cerebral symptoms arose. Following the occlusion the roaring disappeared, the bruit disappeared, and the patient's sight in the left eye began to improve. The exophthalmos gradually diminished and the patient left the hospital sixteen days after the operation markedly improved. Since that time she has been under treatment in the Syphilology Clinic and has remained free from the symptoms for which the operation was done. Her left eye now has about three-quarters normal vision. There is none in the right eye.

### LATE RESULT OF SPLENECTOMY FOR IDIOPATHIC PURPURA

DR. JAMES M. HITZROT presented a case of splenectomy for hemorrhagic purpura—which was reported in the *ANNALS OF SURGERY* for August, 1923, in the person of a girl, eight years old, who was admitted to the First Medical Division, New York Hospital, January 27, 1923, the removal of the spleen being done February 27, 1923. The patient has remained entirely well since the operation and now has practically a normal blood count with normal bleeding time.

### ACUTE PERFORATED PYLORIC ULCER: CONDITION TWENTY-ONE YEARS AFTER OPERATION

DR. ELLSWORTH ELIOT, JR., presented a man, now fifty-nine years of age, on whom he operated for pyloric ulcer at the Presbyterian Hospital, twenty-one years ago. At that time he gave a gastric history extending over seven years, consisting of attacks of indigestion, nausea, and fainting attacks which sometimes interfered with his work for a number of days and at others did not even confine him to the house. There were no bloody or dark-colored stools and the attacks suggested appendicitis rather than gastric ulcer. On the twelfth of December, immediately after lunch, he was seized with intense pain and was taken to the hospital where, at 5 o'clock, his abdomen was opened and a perforated ulcer found on the anterior surface of the duodenum near the pylorus. The operation consisted of the closure of the perforation with a purse-string suture and the insertion of a cigarette drain. During convalescence the patient developed a bilateral phlebitis which eventually completely subsided. Since the operation he has enjoyed excellent health and has been entirely free from all gastric disturbance.

Recently an X-ray study has been made to determine the present condition of the duodenum at the site of the former perforation. This investigation was made by Doctor Imboden, who reports that with the exception of a slight irregularity in its first part, the duodenum as well as the stomach are in every respect entirely normal.

DOCTOR ELIOT remarked that this case is not very exceptional, for of a considerable number of operations for closure of duodenal or pyloric perforations, the majority of patients have remained well without the need of a subsequent gastro-enterostomy. Doctor Imboden is of the opinion, however, in which opinion the reporter agreed, that sufficient investigation with the

## NEW YORK SURGICAL SOCIETY

X-ray has not been done subsequent to the closure of a perforation, to determine the ultimate condition of the stomach and duodenum. In a very considerable number of cases, as in the present instance, the complete and permanent freedom from all subjective gastric disturbance for a long period would indicate that after the closure of a perforation without a gastro-enterostomy the ulcer had remained definitely healed and that a gastro-enterostomy at the time of closure would have been superfluous. The results of gastro-enterostomy in simple ulcer, even though generally satisfactory, are so problematical because of the possible development of marginal ulcer and the need of subsequent surgical measures for recurrence or other complication that it is best to limit the primary operation to a simple closure of the perforation. In this connection some years ago, after an exhaustive study to determine the frequency of subsequent gastric trouble after closure only of perforations, he could find no instance of mechanical pyloric obstruction within the first ten days after operation, and only one or two cases as early as the third week. Usually years elapsed before a gastro-enterostomy for either a recurrence or stenosis proved necessary, if at all. Furthermore he would like to emphasize the fact that in relatively inexperienced hands the addition of a gastro-enterostomy to the closure of the perforation materially increases the operative risk, and that most of these cases, belonging to the emergency class, must necessarily be done by surgeons of limited experience.

### CASE II. GASTRO-ENTEROSTOMY FOR PYLORIC ULCER; SIX YEARS AFTER OPERATION

DOCTOR ELIOT presented also a woman who six years ago had a gastro-enterostomy performed for a typical duodenal ulcer near the pyloric ring. The patient made a good recovery. One year ago she returned with symptoms of enteroptosis. A röntgenogram showed a large excavated ulcer on the lesser curvature and a gastro-enterostomy orifice that was not working. If the ulcer had been situated near the pylorus a second gastro-enterostomy could have been made, but the ulcer was so large and on the lesser curvature that it was decided to postpone any operation. The patient was therefore given medical treatment with subsidence of all subjective symptoms. A few days ago another series of röntgenograms was taken and she was examined fluoroscopically by Doctor Imboden, who found no indication of an ulcer on the lesser curvature and both the stomach and the gastro-enterostomy orifice were working satisfactorily. For some reason, perhaps a spasm, at the time the first röntgenogram was taken the gastro-enterostomy orifice did not work. This case illustrates well that in spite of a gastro-enterostomy recurrence sometimes appears even in aggravated form and that even under unfavorable conditions relief may be obtained without operation. It was the reporter's belief that all such cases should have the benefit of the same medical treatment as is ordinarily adopted for gastric and duodenal ulcers before any operation whatever is attempted.

DR. LEON T. LEWALD (by invitation) said that from the röntgenograms which Doctor Eliot showed, he believed that five out of ten röntgenologists would have made the diagnosis of duodenal ulcer at the present time, which shows how necessary it is to have the personal and clinical history of a case together with the X-ray findings before a röntgenologist can safely venture an opinion which should rarely, if ever, be based on the X-ray evidence alone. Here there is a persistent deformity of the duodenal cap due apparently to

## GASTRO-ENTEROSTOMY FOR PYLORIC ULCER

adhesions which would lead to a diagnosis of a pathological condition being present. These cases should be followed up after a number of years. Doctor LeWald has followed a large number of cases for several months, and in a few instances for several years, after operation.

DR. JOHN A. MCCREERY was of the opinion that about one-half of the perforated ulcers would heal with a simple closure of the perforation. There was, however, a large percentage of cases whose symptoms would recur after this procedure, and he thought that many of these cases could be recognized at operation and, if the patient's condition permitted, a more extensive procedure such as a gastro-enterostomy or in suitable cases a Horsley operation could be performed, so saving the patient a second operation.

In the experience of the First Surgical Division at Bellevue, covering over 40 cases in the past five years, there had been no mortality in the cases selected for immediate gastro-enterostomy.

In two cases in which it seemed advisable simply to close the perforation obstruction, made a secondary gastro-enterostomy necessary within ten days of the original procedure.

DR. GEORGE WOOLSEY said that he had had to re-operate on patients who had been treated for perforation without gastro-enterostomy. One member of this Society had had a second perforation a few years after the first perforation, treated by suture, and he knew of others. Not a few of these cases have to be operated on again later, due to recurrence or of ulcer or perforation to contractures. He believed that when the condition of the patient justified gastro-enterostomy that this was the proper thing to do. It is a safe thing to do and adds to the patient's prognosis both for the present and for the future. As to Doctor LeWald's statement that some röntgenologists would consider that the X-ray Doctor Eliot showed gave evidence of an active ulcer. He had operated that day on a patient at Bellevue Hospital on whom he had operated eight years ago for duodenal ulcer. She was well for two or three years and then symptoms recurred, not those of ulcer, but epigastric fulness, much gas in stomach and pain and tenderness at site of gall-bladder, diagnosed as a gall-bladder condition. Stones were present in the gall-bladder which was removed. Then the duodenum was exposed, but did not present any evidence of ulcer, although the X-ray indicated its presence. He was loath to resect the duodenum, but finally decided to do so on account of a feeling of slight induration posteriorly. It was found that the old ulcer had healed. One could see that the crater had been covered over by continuous mucous membrane, and there was no macroscopic evidence of an active ulcer that the X-ray report had indicated. This was later confirmed by microscopic examination.

DR. WILLIAM B. COLEY stated that his oldest case of perforated ulcer treated by simple closure without gastro-enterostomy is now well, fifteen years later. He believes that surgical opinion at the present time, both here and in England, favors simple closure, reserving gastro-enterostomy for a later operation in case there is a recurrence of symptoms. In his opinion

## NEW YORK SURGICAL SOCIETY

gastro-enterostomy performed as a routine measure at the time of perforation would add distinctly to the mortality; but if reserved for the comparatively small number of cases that later develop recurrence, it can be performed with much greater safety.

DR. JOHN F. CONNORS said that in 1915, he published a report of 45 cases of perforated gastric and duodenal ulcer with 8 deaths. He was very glad to hear Doctor Eliot advocate simple closure in these cases. Personally, he thought this the only thing to do. Four years ago he argued this subject with Doctor Deaver who advocated the additional gastro-enterostomy, but he is still convinced that in the ordinary run of cases simple closure is the ideal method. Doctor Eliot spoke of this case having had no return of symptoms after twenty-one years. Doctor Connors has a case which he operated upon fourteen years ago for two perforations in the anterior wall of the stomach which has remained free from symptoms. In the 39 cases which were closed by suture, in many of which he felt that he caused a pyloric obstruction, in only two of these cases was it necessary to re-operate on account of pyloric obstruction. In reference to the Horsley operation the last two cases upon which this operation was done on his service ended fatally.

DR. CHARLES GORDON HEYD said that for the last four years at the Post-graduate Hospital they had been doing the Horsley operation for duodenal ulcer. He recalled two cases with acute perforation, previous to this time, in which the perforation was closed. The first patient made an uneventful recovery and gave no further evidence of ulcer. The second patient also had the perforation closed and six years later he had a profuse gastric hemorrhage. Röntgen-ray examination revealed no defect and he has been free from symptoms from that time to date. In the last four years in twenty cases in which the Horsley operation had been done, there had been no mortality. This operation accomplishes a complete cure of the ulcer and gives adequate drainage through the pylorus.

DR. RICHARD LEWISOHN said that the question whether one should add gastro-enterostomy in cases of perforated pyloric or duodenal ulcers must be decided by the individual case. If there is marked stenosis after the suture of the perforation, it is wiser to add gastro-enterostomy. Some years ago the speaker advised adding gastro-enterostomy in every case, because he then felt that this operation might be an important factor in the cure of the ulcer. His viewpoint has changed since then and he does not now believe gastro-enterostomy ought to be performed simply as an added factor for the purpose of curing the ulcer. Whether, as often stated, the perforation of an ulcer practically assures a permanent cure, is very doubtful; the speaker has seen many cases that were proof to the contrary. He has seen cases requiring re-operation four years and even more after suture of a perforated ulcer. The secondary operation showed the ulcer in the same place, where it had been found at the time of the perforation.

Regarding Doctor Eliot's second case, it was probable that the ulcer had healed, but only temporarily; he had seen this happen quite often. There is

## GASTRO-ENTEROSTOMY FOR PYLORIC ULCER

a life cycle of an ulcer; they flare up and without treatment they practically disappear, and then flare up again. He did not think it had been proven that the case was improved through medical treatment. The question of how much medical treatment helps in ulcer cases, especially in gastric ulcer, is still an open one.

DR. JAMES M. HITZROT said that he could not agree with Doctor Eliot that ulcer of the lesser curvature was a condition which should be treated medically. He had three cases recently which had been so treated and which finally came to operation with a carcinomatous change in the ulcer. A number of the cases on the First Division at the New York Hospital have been found to be carcinomatous at operation. Balfour makes the statement that ulcers on the lesser curvature are not medical cases because of their tendency to undergo carcinomatous change. Doctor Hitzrot felt that because of this tendency to carcinomatous degeneration operation was much more advisable in the early stages of the disease.

DR. EUGENE H. POOL said that some years ago (*ANNALS OF SURGERY*, 1922, vol. lxxvi, p. 457) Doctor Dineen and he investigated a series of about 59 cases of perforated ulcer to find out what proportion of those in whom the perforation was sutured and no gastro-enterostomy done had recurrence of gastric symptoms and came to operation. They found that about one in three definitely recurred. There were 10 such cases out of a few over 30 followed for some years. Of the 10, 7 had a secondary gastro-enterostomy performed and the other three had pyloric obstruction but refused operation. In some the symptoms developed a considerable period after the first operation. So one may wrongly imagine for a number of years that a patient is cured. If a primary gastro-enterostomy is done as a routine measure, 2 out of 3 cases are subjected to this procedure unnecessarily. In the cases which later need a gastro-enterostomy, it may be done with relative safety and under definite indications. Of course, all the cases must be carefully followed. The point is that routine employment of gastro-enterostomy for perforated ulcers should be condemned. In certain selected cases it should be done. The indications are almost self-evident.

## SARCOMA OF TRACHEA; CONDITION TEN YEARS AFTER OPERATION

DR. ELLSWORTH ELIOT, JR., presented a young man who eleven years ago gave a history of a small lump in the thyroid region of six months' duration, and loss of voice. Examination by the laryngoscope was unsatisfactory, although the vocal cords were narrower, there was some encroachment on the lumen of the upper part of the trachea. On operation a round mass under the thyroid isthmus, which was attached to the trachea and did not move with deglutition, was removed and proved to be a small spindle-celled sarcoma. Haemostasis was satisfactory and convalescence prompt. Eight months afterward he was re-admitted to the hospital with a recurrence and was again operated on by one of his associates. The tumor had then become adherent to the trachea so that a bit of tracheal tissue was excised in its removal and damage was done to the left jugular vein which was quickly repaired. During the past eleven years the patient had coöperated with the follow-up system of

## NEW YORK SURGICAL SOCIETY

the Presbyterian Hospital. During the first two years after operation he was referred to the General Memorial Hospital for treatment with X-ray, and to Doctor Coley for injections of toxins, the latter being continued for one year; about five years ago radium was applied for a period of six months as a precautionary measure. His hoarseness is less now than before the first operation. He is working regularly, has not lost weight or flesh, and X-ray of the chest shows no indication of metastasis.

### ANATOMY AND TREATMENT OF REDUCIBLE INGUINAL HERNIA

DR. ELLSWORTH ELIOT, JR., read a paper with the above title, for which see page 441, September ANNALS OF SURGERY.

DR. WILLIAM B. COLEY said that as to Doctor Eliot's statement that: "It is only in cases of long standing, when the sac is of large size, that the cord may lie along its inner side along the site previously occupied in foetal life by the processus sacciformis an acquired inguinal hernia might naturally be expected to develop; Nature's obliteration of the processus sacciformis, however, is so complete that the resulting connective tissue strand can rarely be identified and the process of repair is so effective that, in an acquired inguinal hernia the parietal peritoneum, finding a path of lesser resistance than that along the obliterated pouch, protrudes through the internal ring along the inner side of the cord and close to the outer side of the deep epigastric vessels. In a large number of incipient inguinal herniae the writer has found this relation constant." His own experience is not in accord with Doctor Eliot's, for he had found the sac to lie anterior to the structures of the cord not only in the so-called congenital type in which the tunica vaginalis communicates with the hernial sac, but in practically all other stages of development of an oblique inguinal hernia from the small incipient sac to the large scrotal hernia. His understanding of the development of a so-called acquired hernia, apparently, differs somewhat from Doctor Eliot's. He believed with Hamilton Russell that practically all cases of oblique inguinal hernia are really of congenital origin; that is, that they develop in an unobiterated process of peritoneum which was present at birth and never became entirely obliterated. Whereas, Doctor Eliot states that Nature's obliteration is so complete that the resulting connective tissue strand can rarely be identified. In all cases of oblique inguinal hernia, both in children and in adults, the speaker had found the sac spread out like a fan over the entire anterior surface of the cord and surrounded in common with the cord by a thin layer of fascia. It is only in the direct type of hernia, in which the sac, never having been inside of this layer of fascia, protrudes forward and usually to inner side without intimate relation with the cord itself as hernia develops.

The relationship of the sac to the cord is well brought out by Hamilton Russell in his paper on *Inguinal Herniae: Their Varieties, Mode of Origin, and Classification* (*British Journal of Surgery*, April, 1922, p. 502). Russell believes that all varieties of oblique inguinal hernia are determined by developmental variations in the anatomy of the processus vaginalis. He states that it would seem practically impossible that a new and acquired sac

## ANATOMY AND TREATMENT OF REDUCIBLE INGUINAL HERNIA

could find its way through the canal and into the scrotum, spreading out in a fan-like manner, having the most close relations with the cord and the vessels and surrounded by a covered membrane.

Doctor Eliot states that in cases of unilateral bubonocele in adults in which the frequency with which a hernia subsequently develops within a comparatively short time on the non-affected side, has led him to advise simultaneous operation on both sides when the external abdominal ring of the non-affected side is lax and of increased dimensions. While this practice has been adopted by a number of well-known surgeons, the speaker had never yet been convinced that it was a wise one. While it is true that operation on the non-affected side or the side on which there is a slightly enlarged ring, often shows the presence of a very slight funicular process or incipient sac well within the internal ring, especially on traction of the cord, he believed that the great majority of these patients may go on for many years and, perhaps, for their entire life, without the development of an actual hernia. A study of end-results in cases at the Hospital for Ruptured and Crippled supports this view.

He was glad to know that Doctor Eliot regards the Bassini operation as one not only well deserving of recognition but one which, in spite of certain minor modifications in technic, is still based on sound surgical principles. It is rather remarkable that an operation which the general concensus of surgical opinion for more than thirty years had regarded as highly satisfactory should suddenly be discovered to be based on erroneous anatomical and surgical principles.

Although Seelig and Chouke, after an elaborate series of experiments on animals reached the conclusion that firm union is impossible when muscle is united to fascia, and that, therefore, it is quite useless to suture the internal oblique to Poupart's ligament, Doctor Eliot's experience, confirmed by that of Dowd and Lyle, show that in human beings, firm and lasting union does occur when the internal oblique is sutured to Poupart's ligament. The speaker was entirely in accord with this opinion. He had operated on many cases of recurrent hernia, in which a small recurrence had taken place at some portion of the canal, usually at the lower end, and yet over the whole remaining portion of the canal the internal oblique was so firmly united with Poupart's ligament that it was almost impossible to dissect it off. He believed that the recurrences in these cases are due to failure in technic rather than to lack of efficiency in the principles of the Bassini operation. Whatever may be the fate of muscle united to fascia in animals, we know that in human beings firm union certainly does occur between the internal oblique muscle and Poupart's ligament when united by proper and careful technic. Recurrences following the Bassini operation usually occur in the internal ring, and this, because too large an opening is made for transplanting the cord. Other recurrences take place in the lower angle of the wound above the pubic spine. The number of both types of recurrence may be materially lessened by observing the following points at operation: (1) placing a suture above the cord, limiting the size of the internal ring to the size of the cord in the individual

## NEW YORK SURGICAL SOCIETY

case; (2) for the lowermost suture using the stitch described in the article on Hernia in *Keen's Surgery*, vol. iv. This suture is so placed as to include the reflected portion of the external oblique and conjoined tendon, both of which are brought into contact with Poupart's ligament just as it enters the pubic spine, thus uniting fascia to fascia instead of muscle to fascia. For suture material, he advocates the use of medium-size kangaroo tendon.

A modification which Doctor Eliot has made use of, *i.e.*, overlapping the external oblique fascia, is of very great value in certain cases where the aponeurosis is particularly lax, and especially, in direct hernia. In the great majority of cases of inguinal hernia, especially in young adults, the aponeurosis is not lax and could not be made to overlap the cord without undue pressure; in these cases the overlapping is entirely unnecessary. Furthermore, his own results show that the typical Bassini operation, supplemented by the use of the sutures he had described, is capable of producing a permanent cure in the great majority of cases.

Seelig's idea that muscle will not unite to fascia has been adopted by Gallie, Edmund Andrews, and others; and the opinion is freely expressed that the number of recurrences following the Bassini operation is at present very large. Furthermore, the statistics of the Hospital for Ruptured and Crippled are held in light regard on the ground that they cover mostly hernias in children which can easily be cured by any method of treatment. This view is held by some in spite of the fact that, prior to the adoption of the Bassini operation at the Hospital for Ruptured and Crippled, the statistics showed 40 per cent. recurrences in children in one year; since the adoption of the Bassini method the percentage of recurrences in children has been less than one. Another criticism of the statistics of the Hospital for Ruptured and Crippled is, that the cases have not been followed up, and that if they had, the number of recurrences in adults would be found to be very large. He had just recently taken occasion to examine a series of 100 cases operated upon by himself by the Bassini method, with the use of kangaroo suture, in the years 1895 to 1897 inclusive; the types of hernia included are: large irreducible, sliding cæcal, femoral, ventral, and oblique inguinal; ninety cases were traced from one to fourteen years; there were only two relapses, one, a slight weakness which developed almost two years later, and the other, a small recurrence which developed two and one-half years later following a kick received while fighting. Our recent statistics show a larger percentage of recurrences in adults, but this I believe may be accounted for by the fact that a very much larger number of patients are now being operated upon and it is extremely difficult to get a follow-up note on many of these cases; furthermore, a much larger number of operations are now being performed by the house-staff.

The real problem of the radical cure of hernia that has not been solved—or at least not until recently—is connected with direct hernia. It is probable that 10 to 15 per cent. of recurrences follow operations for direct hernia, even in the hands of skilful operators. Great improvements have been made in the technic of operation for direct hernia by Bloodgood, Downes, Andrews,

## ANATOMY AND TREATMENT OF REDUCIBLE INGUINAL HERNIA

Schley and others; but the greatest advance in the treatment of this type of hernia must be credited to Gallie, of Toronto. While the method of using fascial strips for sutures was originated by McArthur twenty-four years ago, these strips were left attached at their proximal end and they were limited in supply to the fascia of the external oblique. Gallie conceived the idea of fascial strips retaining their vitality indefinitely without attachment, and he confirmed the truth of this opinion by many experiments on animals. He then cut strips of fascia from the fascia lata of the thigh and used these sutures to close the large openings of direct hernia and recurrent hernia, and showed 60 cases thus treated, without recurrence. The speaker began using this method a little over a year ago and had now operated upon 60 cases of large direct and large recurrent hernia, with so far only two relapses; practically all of these cases have been traced. It is important to note that neither Gallie nor McArthur advise the use of fascial strips as a routine measure, but reserve this method for cases of large direct, and recurrent hernia.

DR. F. T. VAN BUEREN, JR., said that he agreed with Doctor Eliot that the sac was on the inner side of the cord. One can demonstrate this easily by displacing cord outward and find sac beneath it and to inner side of it.

DR. H. H. M. LYLE said that in the discussion of the suture materials where applicable, he used the McArthur attached fascial strips. He has employed this method in more than one hundred cases. He had at first used the Gallie method of detached strips from the fascia lata, but now reserves the Gallie method for those cases in which sufficient fascia cannot be obtained from the external oblique.

The use of fascia as a suture material in hernia is based on sound physiological principles. It is a strong, supple, living suture which becomes intimately incorporated in the structures. Doctor Lyle emphasized that no matter what the suture material was, all tension must be avoided. Tight suturing means tissue tension, impairment of nutrition and the possibility of a replacement fibrosis. Such tension can be easily avoided by the elementary procedure of placing parts in a position of muscular rest. The flexed and relaxed position simplifies closure, aids union and insures a comfortable convalescence.

DOCTOR LYLE has employed the position of physiological muscular balance for fifteen years and found it most satisfactory. For details he referred to his paper on "Value of Position in Operative Treatment of Inguinal Hernia," S.G.O., November, 1920, pp. 529-530.

DR. SEWARD ERDMAN remarked as to Doctor Eliot's statement as to the relation of the sac to the structures of the spermatic cord in the ordinary oblique inguinal hernia. His idea had always been that the oblique sac lies superficial to the cord, in the inguinal canal. When the sac and cord are dissected well up to the internal ring, the structures are found to be arranged in the form of a rough triangle; the vessels to the outer side; the vas to the inner side and the neck of the hernial sac above and between, thus the hernial sac appears to have "skidded" out between and a little above the spermatic vessels which lie lateral and the vas which lies mesial.

## NEW YORK SURGICAL SOCIETY

As for Doctor Eliot's statement regarding the frequency with which a potential hernia exists on the side opposite to that on which the definite hernia is present, Doctor Erdman said that in his own statistical study of inguinal hernia, published some years ago, direct hernia sooner or later was demonstrated to be bilateral in 66 per cent. of all cases; whereas in oblique hernia 25 per cent. eventually developed bilateral herniae.

DOCTOR ELIOT, in closing the discussion, said that his paper dealt with oblique inguinal hernia in the adult rather than in children, and the relation he had tried to emphasize of the neck of the sac to the cord pertained to adults. He could quote at least one instance in support of the theory that the sac in oblique inguinal hernia does not follow the original course of congenital hernia. That was observed in a young adult of sixteen in which a peritoneal pouch without any communication with the peritoneal cavity was found in the inguinal canal. On further investigation the actual hernial sac was found lying to the inner side of this pouch, while its neck was interposed between the cord and deep epigastric vessels, as demonstrated in the paper. The writer had stated that eventually a rotation of the neck of the sac around the cord occurred with the result that ultimately the sac lies anterior and to the outer side of the cord in the position Doctor Coley describes. The only way to settle the question is for both to search for the sac; for Doctor Coley to watch Doctor Eliot during an operation and *vice versa*, when a satisfactory conclusion might be reached. Doctor Coley believes that the sac lies at the outer side of the cord; the speaker believes that the cord lies between the deep epigastric vessels and the vas deferens.

If Doctor Coley remains unconvinced, the writer is certain that by actual demonstration on the living subject the position of the sac could be substantiated as herein described.

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